POWER

A McGRAW-HILL PUBLICATION—ESTABLISHED 1884

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Volume 72 NEW YORK, NOVEMBER 25, 1930 *Number 22*

Engineers' Week in New York

EMERGING from a great power station, a visit to which was one of the features of an engineering society's meeting, one of the ladies exclaimed, "Is there any one man who knows what this is all for and what to do with it?"

There is, good lady, and one who knew enough to conceive and construct it, but he does not often get a curtain call.

Nothwithstanding the important part that the engineer plays in the passing show, he works, for the most part, behind the scenes.

The average city dweller has little conception of the planning and contriving, the expenditure of ingenuity and scientific application that are involved in the industrial processes that support the world and in the services that make metropolitan living possible.

Next week the American Society of Mechanical Engineers, an organization of some twenty thousand of the sort of men who make these things possible, holds with other engineering bodies its annual meeting in New York. Here their problems will be discussed, their achievements recorded, and honors bestowed upon a few for outstanding accomplishment.

At the same time there will be open to those interested a Power Show, where will be displayed the apparatus and appliances used in the generation and transmission of the power upon the availability of which our whole modern system of industry and community life depends.

As its contribution to the occasion *Power* offers this collection of power-plant equipment "hook-ups." In addition to their usefulness and value to the general reader, their study will kindle in the visitor to the Power Show a keener interest in their constituent parts there exhibited.

And at the functions, professional and social, of the societies he may meet the men who design and produce these elements, and the men who co-ordinate and combine them into harmonious and efficient units, producing dependably and economically, that power which has come to be one of the basic factors of our modern mode of living.

F. R. Low

EDITORIAL

Master Flow Sheets For Power Engineers

POWER HOOK-UPS are the theme of this number. Blue prints and terse comments are used for their presentation. The result is a graphic treatise of immediate and lasting value to engineers who demand teamwork of equipment as well as of men. Here, for the first time, consulting engineers, public and private operating companies, operating men and other students of power production will find immediately at hand, and under one cover, a comprehensive summary of fundamental power-unit combinations.

The term "hook-up," as here used, denotes a basic sequence. Piping arrangements are omitted, as they can be considered only after deciding what major items, and which sequence, will best suit the conditions of the particular plant. For the same reason, incidental and control connections that do not affect the basic sequences are generally omitted. No attempt is made to show equipment in other than diagrammatic form or to indicate features of design and construction. These things and many others are subordinated to the dominant idea of producing a reference volume of permanent value, regardless of transitory styles and modes.

The reader will find here thirty full-page blue prints, including one hundred and ten individual hook-up diagrams. Each shows, in the most direct manner possible, one method of connecting two or more major power units.

Power generation (by steam, diesel or hydro) is treated at length, as are refrigeration, heating and air conditioning. Many combinations of process-heat supply and waste-heat recovery with steam and diesel power generation are shown. High-pressure steam plants, binary-vapor cycles, steam storage and hydro combinations receive the same fundamental treatment.

Certain major equipment groups are so flexible in their possible sequences as to warrant separate consideration. Those thus presented include condensing hook-ups, draft circuits, coal handling and preparation, ash handling and combinations of superheating and desuperheating elements.

Traditionally, words are more important than illustrations. Actually, the reverse is often true. Certainly here. This whole number centers about the blue prints. Reading is secondary and will follow naturally in the search for answers to questions that arise as the various hook-ups are analyzed and compared. Ideas crystallized and tested in such studies may eventually lead to the construction of an entirely new plant or a revamping of the present plant.

Before one can decide wisely what to do, he must know what has and can be done. Here are the master charts broadly depicting the possibilities.

▼

POWER *Stands for . .*

1. Making Power When It Should Be Made
2. Buying Power When It Should Be Bought
3. Cheaper Power Through Modern Equipment
4. Easier Financing of Equipment Purchases
5. Better Use of Byproduct Heat and Power
6. Operating Methods That Save Money
7. Less Waste in Transmission and Application
8. Prevention of Smoke, Within Reason

▼

HOOK-UP GROUPS:

Steam Power Generation (PAGE 824)

High-Pressure Steam Power Plants (PAGE 827)

Binary-Vapor Cycles (PAGE 830)

Steam Power and Process (PAGE 832)

Waste-Heat Utilization (PAGE 837)

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Hydro Hook-Ups—With Pumped Storage (PAGE 846)

Ash-Handling Diagrams (PAGE 848)

Coal Handling and Preparation (PAGE 850)

Feed-Water Treatment (PAGE 855)

Draft-Circuits: Fans, Economizers, Air Heaters (PAGE 858)

Condensing-Water Circuits (PAGE 860)

Superheating and Desuperheating (PAGE 862)

Refrigeration Hook-Ups (PAGE 864)

Heating and Air Conditioning (PAGE 867)

Steam Power Generation

THE hook-ups are for plants generating power only, without process steam. They show four fundamental ways of heating feed water: with exhaust from individual auxiliaries, with exhaust from house turbine, with extraction steam and by economizer. The diagrams also show three fundamental surge-tank arrangements. Many details such as main steam line drips, heater vents and condenser circulating water systems have been omitted to simplify the diagrams and so make the main system easy to follow. Additional information on feed-water treatment, induced and forced draft, condensing water circuits and superheating is given in the articles which start on pages 855, 858, 860 and 862.

1

Description: Feed-water heating with exhaust steam from various steam-driven auxiliaries.

Application: Industrial power plants.

Remarks: First cost is low for small plants. High over-all efficiency can not be obtained. Storage capacity of open heater takes care of surge requirements.

2

Description: Feed water heating with exhaust steam from house turbine which supplies power for motor-driven auxiliaries. Generator is connected to the station bus through proper transformers. Load on unit is governed by feed heating requirements, and energy generated in excess of auxiliary requirements is delivered to the station bus. Circulating pump in condensate line after steam-jet air cooler is operated to maintain constant level in hot water storage tank. Surge is taken by cold-water tanks. Evaporator condenser receives also gland sealing steam from main unit.

Application: Used in utility and large industrial plant with moderate initial steam pressure and steady load.

Remarks: Fairly high over-all efficiency can be obtained. Load on house turbine and speed of circulating pump require constant attention of operator. Where coal is expensive and load factor high an economizer would probably be justified.

3

Description: Feed-water heating with steam bled from two stages of main unit. Energy for motor-driven auxiliaries is obtained either from station bus through transformers or from condensing house turbine.

Application: Industrial power plants and central station.

Remarks: Good over-all efficiency. Easy to operate. First cost low.

4

Description: Combination of hook-ups 1 and 2. Moderately high steam pressure is assumed and an economizer has been added to the feed heating equipment.

Application: Central stations.

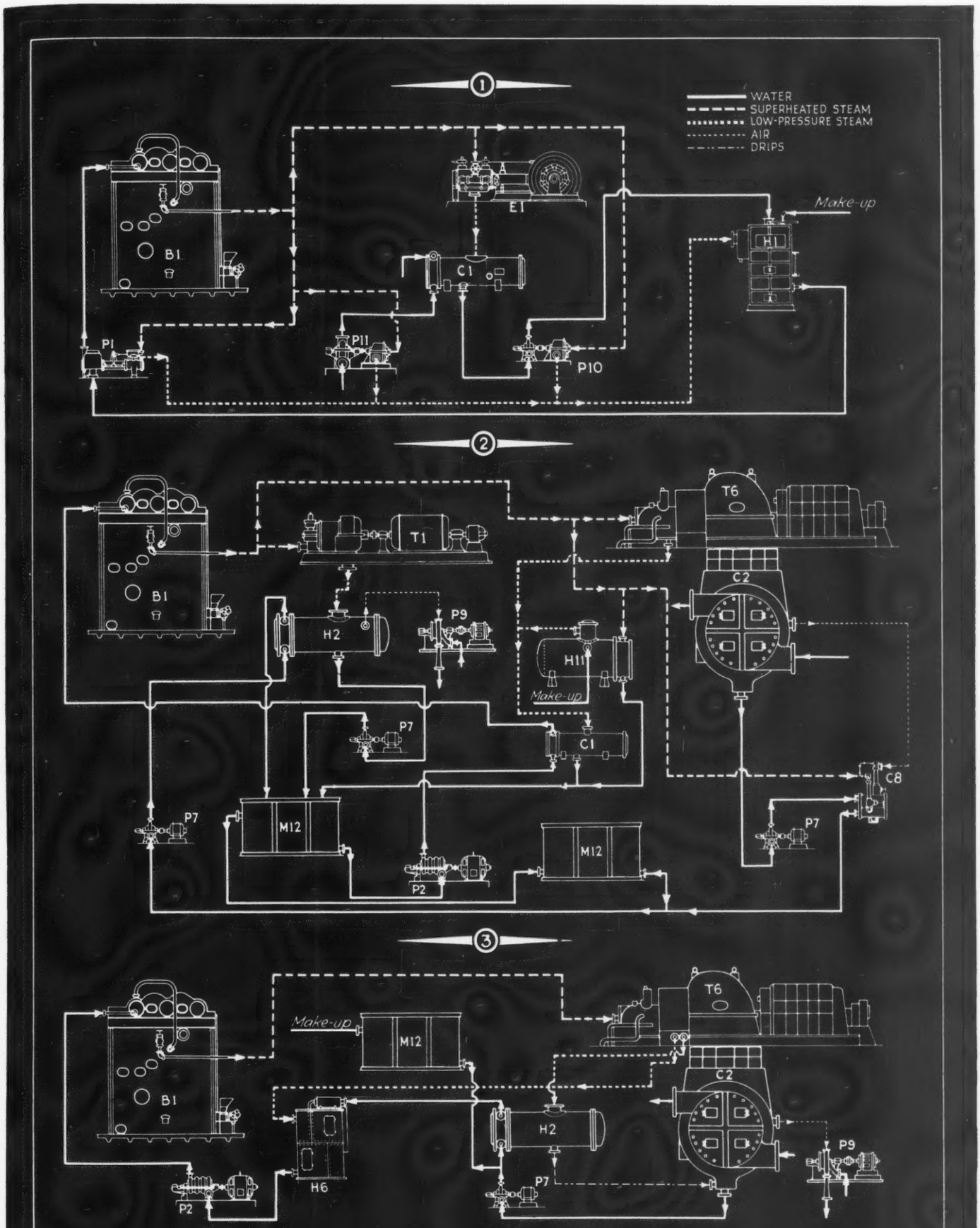
Remarks: High over-all efficiency can be obtained. With only one or two main units it is easy to operate, but as number of units increases the division of feed water to bleeder heaters becomes complicated. Locating feed pump ahead of closed heaters increases their first cost and in this case is probably not necessary.

5

Description: Four-stage feed heating with evaporated make-up.

Application: Central stations.

Remarks: High over-all efficiency. Easy to operate. Float valve arrangement for controlling surge water eliminates additional pumps or high elevation of surge tank. Only one feed-water heater is subjected to boiler feed pressure.



B1—Boiler
C1—Surface Condenser
C2—Surface Condenser
C8—Steam-Jet Air Ejector
E1—Steam Engine
H1—Open Heater
H2—Closed Heater
H6—Deaerating Heater
H11—Evaporator
M12—Tank
P1—Duplex Pump
P2—Feed Pump
P7—Condensate Pump
P9—Hurling-Water Air Pump
P10—Condensate Pump
P11—Circulating Pump
T1—House Turbine
T6—Condensing Turbine

STEAM POWER GENERATION

POWER Nov. 25, 1930
Hook-Up Number

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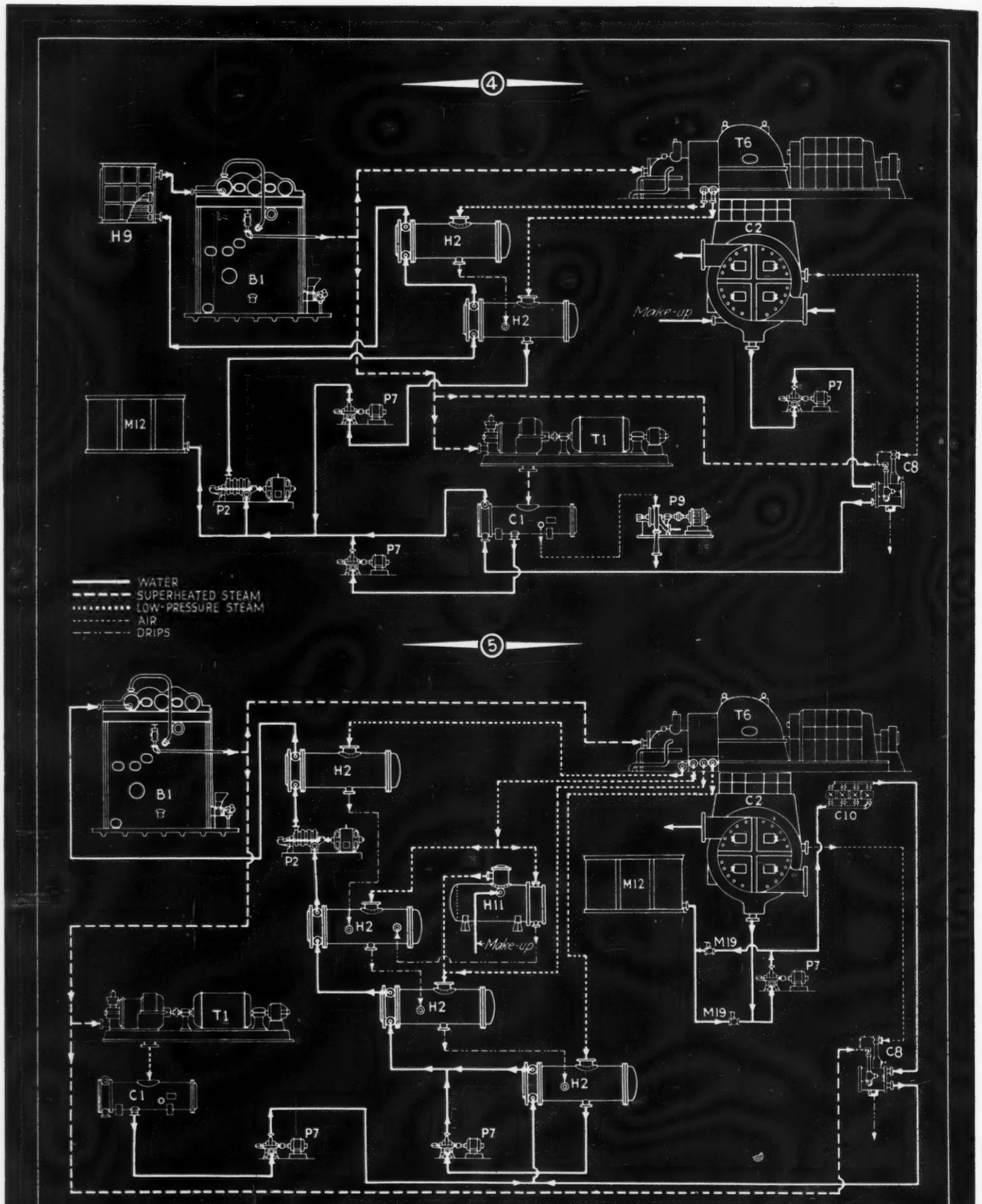

B1—Boiler
C1—Surface Condenser
C2—Surface Condenser
C8—Steam-Jet Air Ejector
C10—Gen. Air Cooler
H2—Closed Heater
H9—Economizer
H11—Evaporator
M12—Tank
M19—Float Valve
P2—Motor-Driven Feed Pump
P7—Condensate Pump
P9—Hurling-Water Air Pump
T1—House Turbine
T6—Condensing Turbine

STEAM POWER GENERATION

POWER Nov. 25, 1930
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High-Pressure Steam Power Plants

HOOK-UPS for plants in which the steam pressure ranges between 500 and 1,400 lb. They show three methods of reheating the steam between high- and low-pressure turbines. All but one of the diagrams show make-up evaporators, as pure feed water is considered essential in high-pressure plants. Only the standard type boiler has been shown, although the Benson, Loeffler and Schmidt-Hartman types are applicable. With initial steam temperature of 750 deg., reheating is essential with steam pressure over 550 lb. if blade erosion due to moisture is to be avoided in the final low-pressure stages of the turbine.

1

Description: This hook-up is for a steam pressure of about 600 lb. Feed water is heated with extraction steam in three closed heaters and in an economizer. Make-up is assumed to be treated chemically by one of the methods shown in the feed treatment hook-ups (page 855).

Application: Central stations.

Remarks: Because of the necessity of reheating the first cost is high in comparison to the possible gain in efficiency. Feed water can be pumped by one set of feed pumps. The deaërating heater has sufficient capacity to handle any ordinary amount of surge water, but in emergency a float valve before the deaërator closes and water will overflow to the storage tank.

2

Description: A 1,200-lb. plant superimposed upon an existing plant operated at about 300 lb. pressure. Reheating is by high-pressure steam. Provision is made for supplying steam from the high-pressure boilers to the low-pressure system in case the high-pressure turbine is out of service. The desuperheater is necessary only in case the low-pressure turbines are unable to stand high-temperature steam. Feed water is heated in three closed heaters, a deaërating heater and economizer. Make-up is evaporated. Deaërating heater is assumed to have sufficient storage capacity to take care of surge requirements.

Application: May be added to any existing moderate-pressure central station.

Remarks: Steam reheating eliminates complex piping and is low in first cost, but high superheat cannot be obtained. Condensate from the reheater is discharged to the feed pump. With 1,200 lb. pressure primary and secondary feed pumps are necessary. In case steam from the low-pressure boilers is used in the low-pressure turbine the primary feed pump would be piped to return the condensate to the low-pressure system.

3

Description: A pressure of 1,200 lb. is assumed and gas reheating is employed between high- and low-pressure turbines. Extraction steam is used in two closed heaters, and a third closed heater receives steam from the exhaust of the high-pressure turbine. Make-up water is evaporated by extraction steam and condensed in a deaërating heater. Additional storage and surge capacity is provided by the hot-water tank.

Application: Central station.

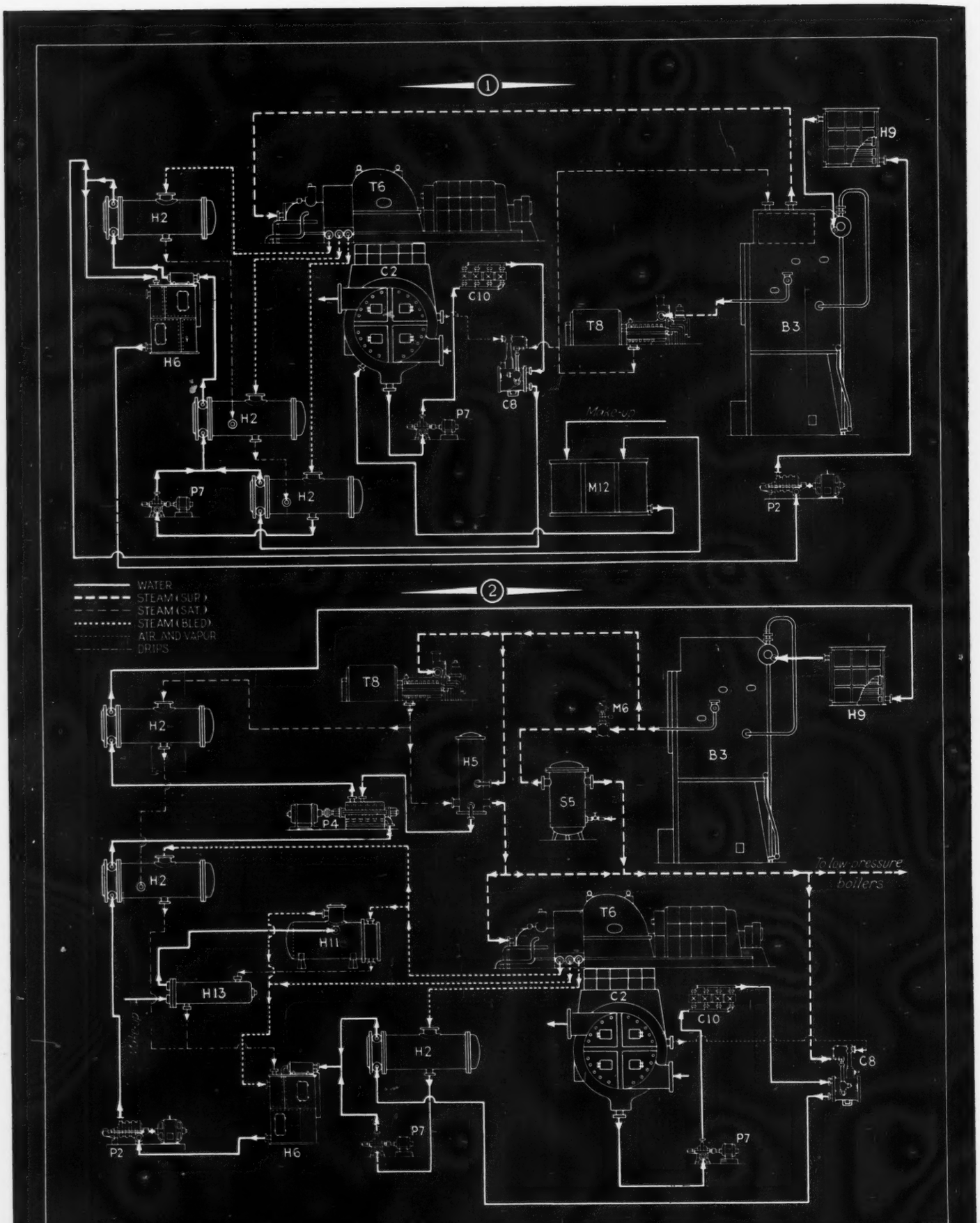
Remarks: Gas reheating insures high reheat temperature but requires expensive piping from turbine room to boiler. Reheat temperature increases with boiler rating. If a reducing valve is installed for bypassing the high-pressure turbine when it is out of service, protection for the gas reheater must also be provided. This may be accomplished by passing the steam through a desuperheater and then through the reheater or by bypassing the flue gas around the reheater.

4

Description: This hook-up shows a combination of steam and gas reheating.

Application: Central station.

Remarks: Addition of a steam reheater boosts the steam temperature at low loads, tending to make more uniform reheat temperature. Steam reheater is placed above boiler so that drips will drain back to boiler drum by gravity. Arrangement of surge tank is complicated and requires additional pumps.



B3	High-Press. Boiler	**H6**	Deaerating Heater	**P2**	Feed Pump
C2	Surface Condenser	**H9**	Economizer	**P4**	H.P. Feed Pump
C8	Steam-Jet Ejector	**H11**	Evaporator	**P7**	Condensate Pump
C10	Gen. Air Cooler	**H13**	Heat Exchanger	**S5**	Desuperheater
H2	Closed Heater	**M6**	Reducing Valve	**T6**	Condensing Turbine
H5	Steam Reheater	**M12**	Tank	**T8**	H.P. Turbine

HIGH-PRESSURE STEAM PLANTS

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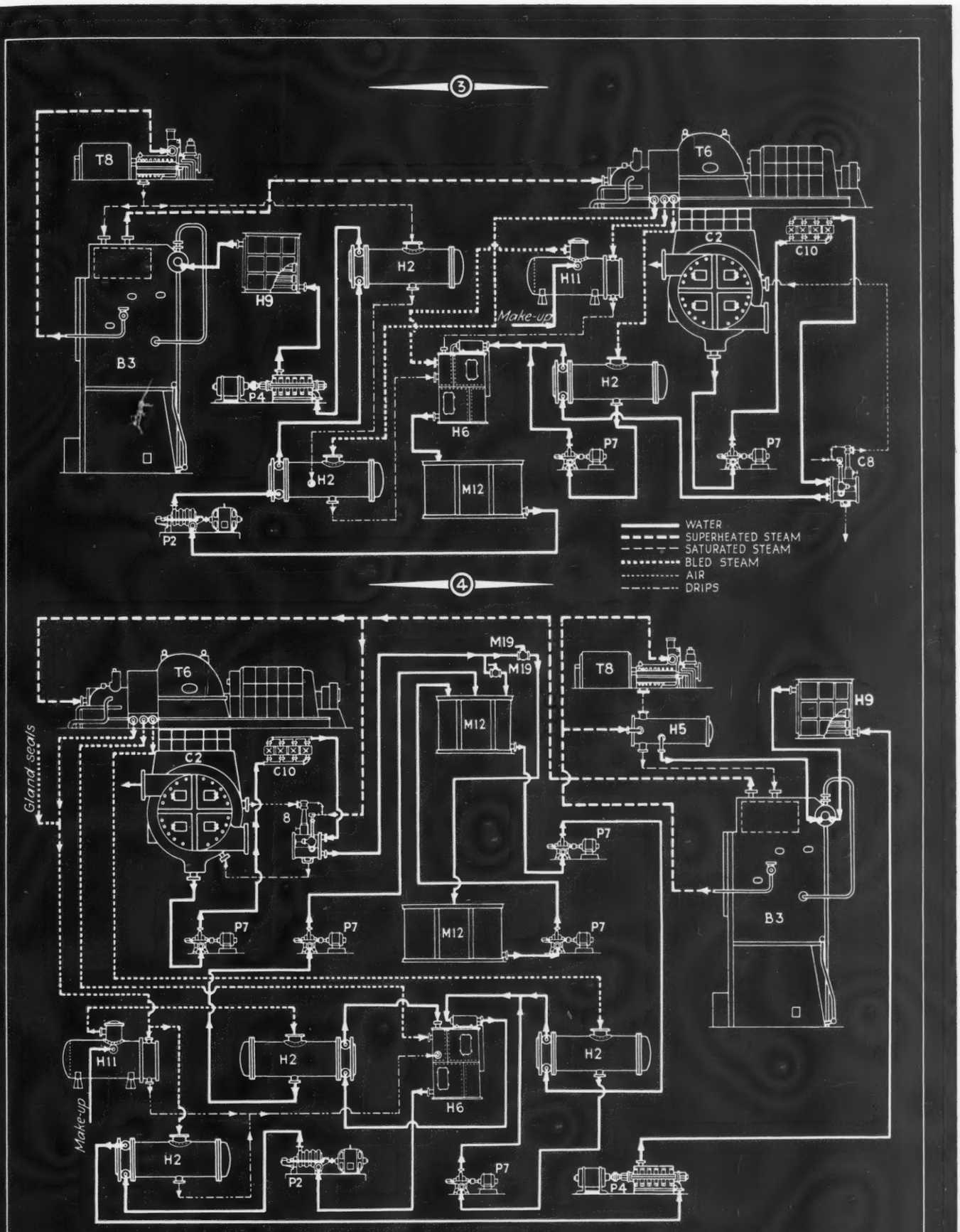

B3—H.-P. Boiler
C2—Surface Condenser
C8—Steam-Jet Air Ejector
C10—Gen. Air Cooler
H2—Closed Heater
H5—Steam Reheater
H6—Deaerating Heater
H9—Economizer
H11—Evaporator
M19—Float Valve
M12—Tank
P2—Motor-Driven Feed Pump
P4—H-P Feed Pump
P7—Condensate Pump
T6—L-P Turbine
T8—H-P Turbine

HIGH-PRESSURE STEAM PLANTS

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Binary-Vapor Cycles

THE two binary cycles shown are mercury-vapor and ammoniacate. The mercury-vapor cycle has been thoroughly tested in a large unit. The ammoniacate cycle has not as yet been applied commercially. This cycle, in addition to employing steam and ammonia as working vapors, utilizes the heat associated with a chemical reaction. In both cycles heat is added to the primary media at high temperature and relatively low pressure, and the increase in efficiency is greater than can be obtained by superheating steam to the same temperature at the highest pressure now used commercially in steam turbines.

1

Description: Mercury is evaporated in a specially designed boiler at high temperature and relatively low pressure. It expands in a turbine and exhausts at high vacuum to a condenser which is also a steam boiler. Steam generated at about 300 lb. pressure by the condensing mercury vapor is superheated and delivered to a steam power plant of normal design.

Application: As addition to existing central stations and new plants.

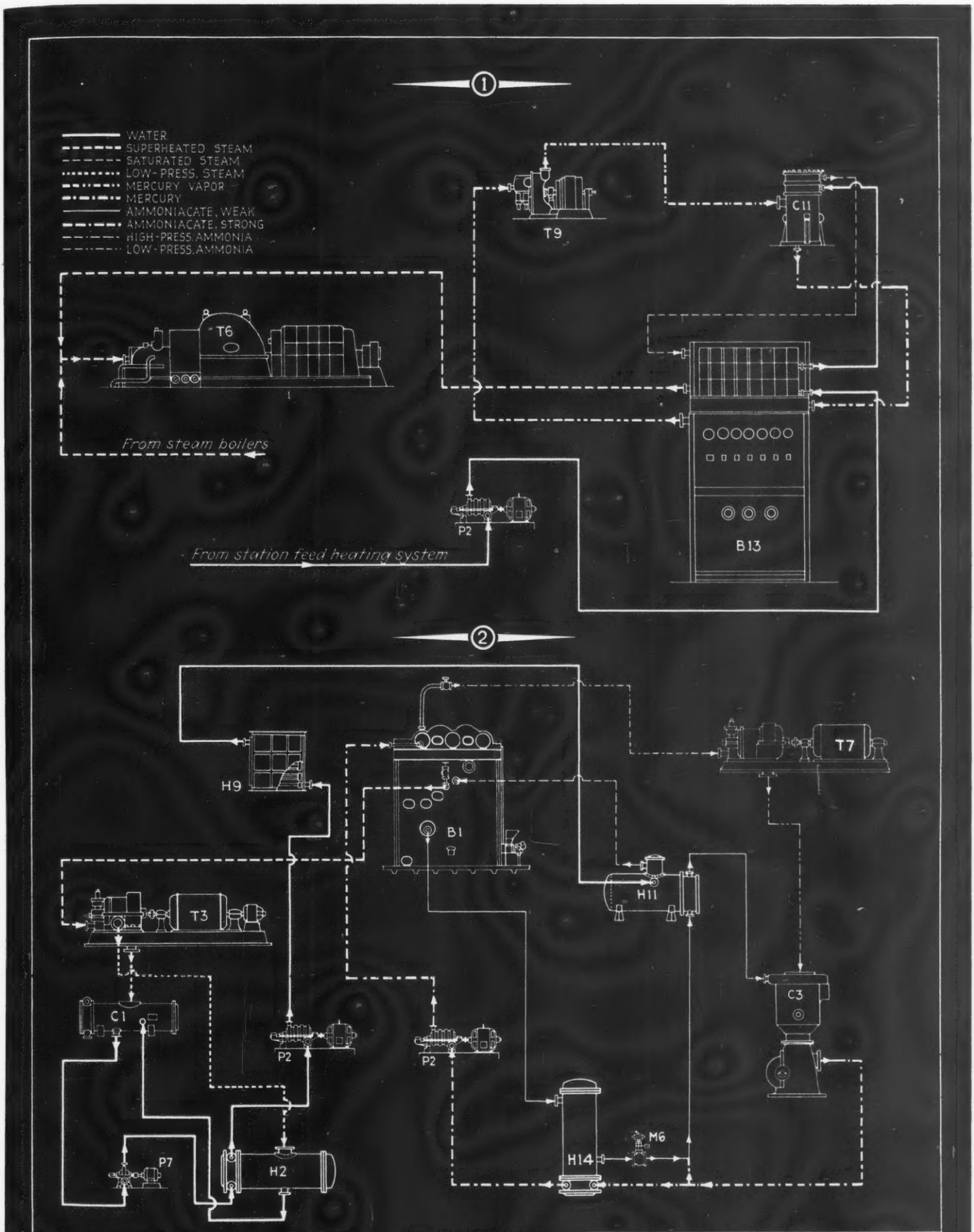
Remarks: Very high efficiency can be obtained. The plant at Hartford, Conn., has produced a net kilowatt-hour from less than 10,000 B.t.u. fuel input. The gain in efficiency is partly offset by high cost of mercury. Operation is extremely simple, as no pumps are required to handle the mercury. Mercury turbine and condenser are above the boiler, to which the mercury returns by gravity. Mercury vapor is poisonous and great precautions are necessary to prevent its escape to the atmosphere of the plant.

2

Description: This cycle utilizes two amoniacate salts (mixed) in the boiler, zinc chloride di-ammoniacate and zinc chloride mon-ammoniacate. In the boiler the di-ammoniacate decomposes in part to the mon-ammomniacate, and highly superheated amonia vapor is evolved. After expanding through a turbine the amonia vapor recombines in a mixer with mon-ammoniacate (weak ammoniacate) taken from the boiler to form di-ammoniacate (strong ammoniacate), which is returned to the boiler. Before entering the mixer the high-temperature mon-ammoniacate passes through an evaporator, where steam is generated. This steam is superheated and used in the normal steam plant. For complete description of this cycle see *Power*, Oct. 28, 1930.

Application: As addition to existing central stations and new plants.

Remarks: High efficiency is possible. Ammoniacate is relatively inexpensive. Ammonia vapor is inflammable. Ammoniacate is a solid at room temperatures.



BINARY-VAPOR CYCLES

POWER Nov. 25, 1930

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Steam Power and Process

MOST of the hook-ups shown involve the generation of by-product power from steam used later for process and heating. There has been no attempt at consistency in showing reducing valves, feed pumps, condensate and circulating pumps and other essential auxiliaries. The earlier diagrams are fairly complete in these respects, but for sake of simplicity, many such details are dropped in the later diagrams. In diagrams 8, 9, 10, the symbol Pl (duplex pump) represents any steam-driven auxiliary operating in the given range.

1

Description: Plant supplying process steam at boiler pressure and at low pressure, without power generation.

Application: In plants where steam or power demands are too low to make by-product power generation practicable.

2

Description: Back-pressure engine exhausting to process and heating (also feed heating).

Application: In industrial plants of small and moderate size where maximum output of by-product power is desired.

Remarks: This is an ideal arrangement where the steam and power loads are such that practically all power required can be generated as a by-product.

3

Description: Power generated by condensing turbine. All process steam supplied direct from the boiler, lower pressures through reducing valve.

Application: Properly used where process steam demands are very small. Also in some cases where an oversupply of steam from waste heat, or waste fuel, is available.

4

Description: Engine expanding steam from boiler pressure to low-pressure process. Turbine expanding steam from boiler pressure to condenser.

Application: Where back-pressure engine alone cannot supply power demand at all times.

5

Description: Turbine expanding some steam from boiler pressure to process bleed point and remainder to condenser.

Application: Where effect obtained in 4 is desired with a single unit.

Remarks: Whereas 4 is more commonly the result of adding to an old plant, the arrangement 5 would be more suitable for a new plant.

6

Description: Engine- and steam-driven plant auxiliaries expanding from boiler pressure to low-pressure process. Excess exhaust over low-pressure process demands passing to mixed pressure turbine, which also expands steam from boiler pressure to condenser.

Application: A desirable way to increase the power capacity of existing plants with maximum flexibility.

7

Description: Engine expanding steam from boiler pressure to low-pressure process. Turbine expanding steam from process pressure to condenser.

Application: A very inexpensive and satisfactory way to increase the power of an existing non-condensing plant.

8

Description: Turbine expanding from boiler pressure to intermediate process pressure. Engine expanding from intermediate process pressure to low process pressure, turbine expanding from low process pressure to condenser.

Application: Because of complication and high first cost, a new plant would rarely be laid out in this way, but addition of the high-pressure boiler and turbine is in many cases a sensible way to increase capacity of existing plant.

9

Description: Boiler steam expanded through first cylinder of two-cylinder turbine to intermediate process pressure, expanded from intermediate process pressure to low process pressure through steam-driven auxiliaries, expanded from low process pressure to condenser through second cylinder of turbine.

Application: Used (chiefly abroad) where it is desired to add a single unit utilizing power generation ranges above and below those of existing steam-driven auxiliaries.

Remarks: This installation would generally require a new boiler of fairly high pressure.

10

Description: Back-pressure turbine expanding from boiler pressure to low process pressure. Bleeder turbine expanding from boiler pressure to condenser, and bleeding to intermediate process pressure; also to low process pressure.

Application: Chiefly where back-pressure turbine is already installed, and it is desired to produce more power and supply an additional pressure level.

11

Description: Back-pressure turbine expanding from boiler pressure to low process pressure. Ejector-type steam compressor mixes exhaust steam and boiler steam to produce process steam at intermediate pressure.

Application: Where small amounts of process steam at intermediate pressures are desired.

Remarks: Utilization of some exhaust steam, with consequent fuel saving, is made possible.

12

Description: Motor-driven heat pump compresses some of exhaust of back-pressure turbine for use in intermediate-pressure process.

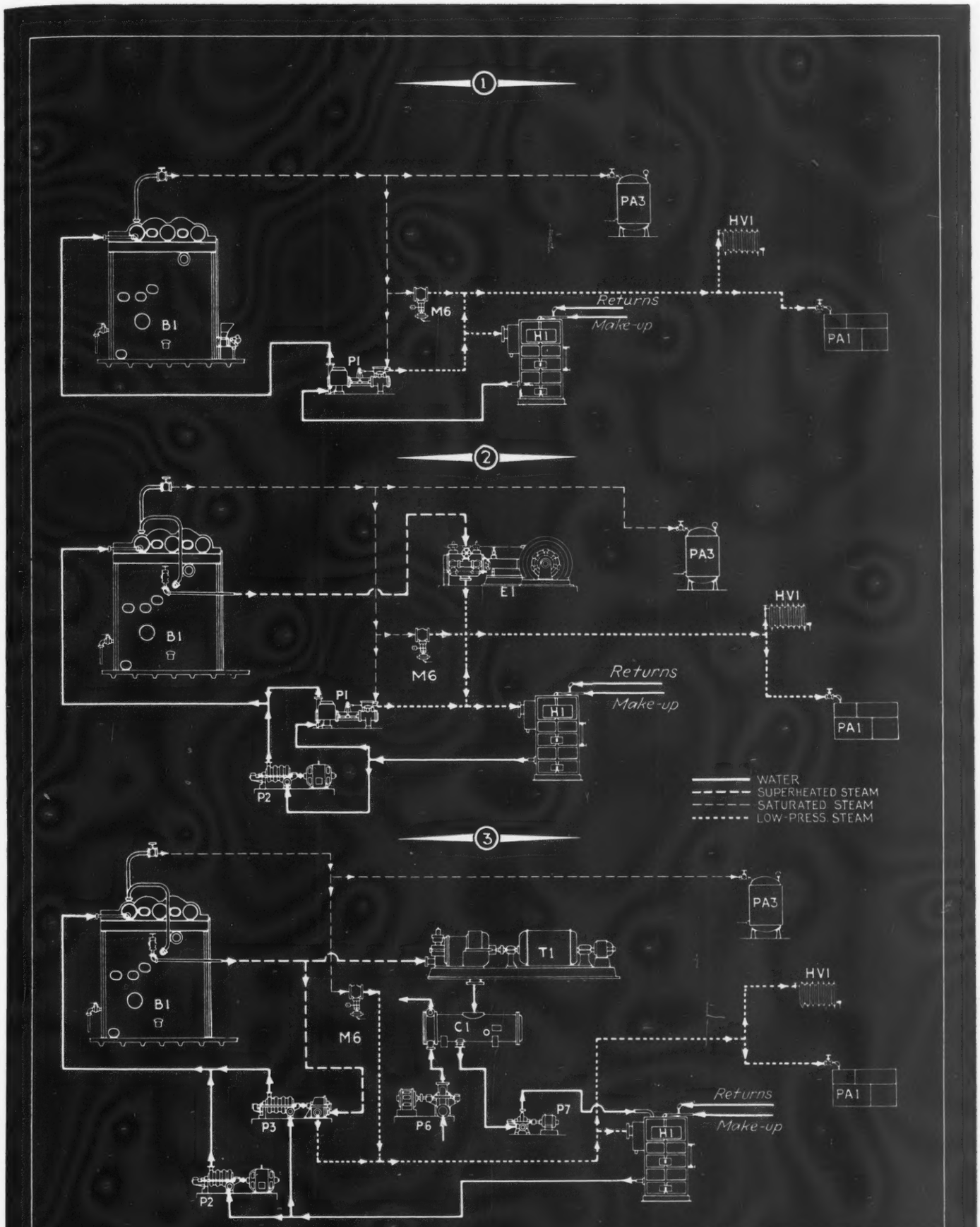
Application: Where small amounts of intermediate-pressure steam are desired for process use at distant points.

13

Description: High-pressure boiler supplies two high-pressure turbines, one exhausting to condensing turbine, and the other to evaporator supplying process steam.

Application: In high-pressure central stations or other high-pressure plants where process steam must be supplied, but where operating conditions do not permit a high percentage of make-up.

Remarks: The evaporator returns to the feed system all the steam supplied to its high-pressure turbine.



B1—Boiler
C1—Surface Condenser
E1—Steam Engine
H1—Open Heater
HV1—Heating
M6—Reducing Valve
P1—Duplex Pump
P2—Motor-Driven Pump
P3—Turb.-Driven Pump
P6—Circulating Pump
P7—Condensate Pump
PA1—Low-Press. Process
PA3—High-Press. Process
T1—Condensing Turbine

STEAM POWER AND PROCESS

POWER Nov. 25, 1930
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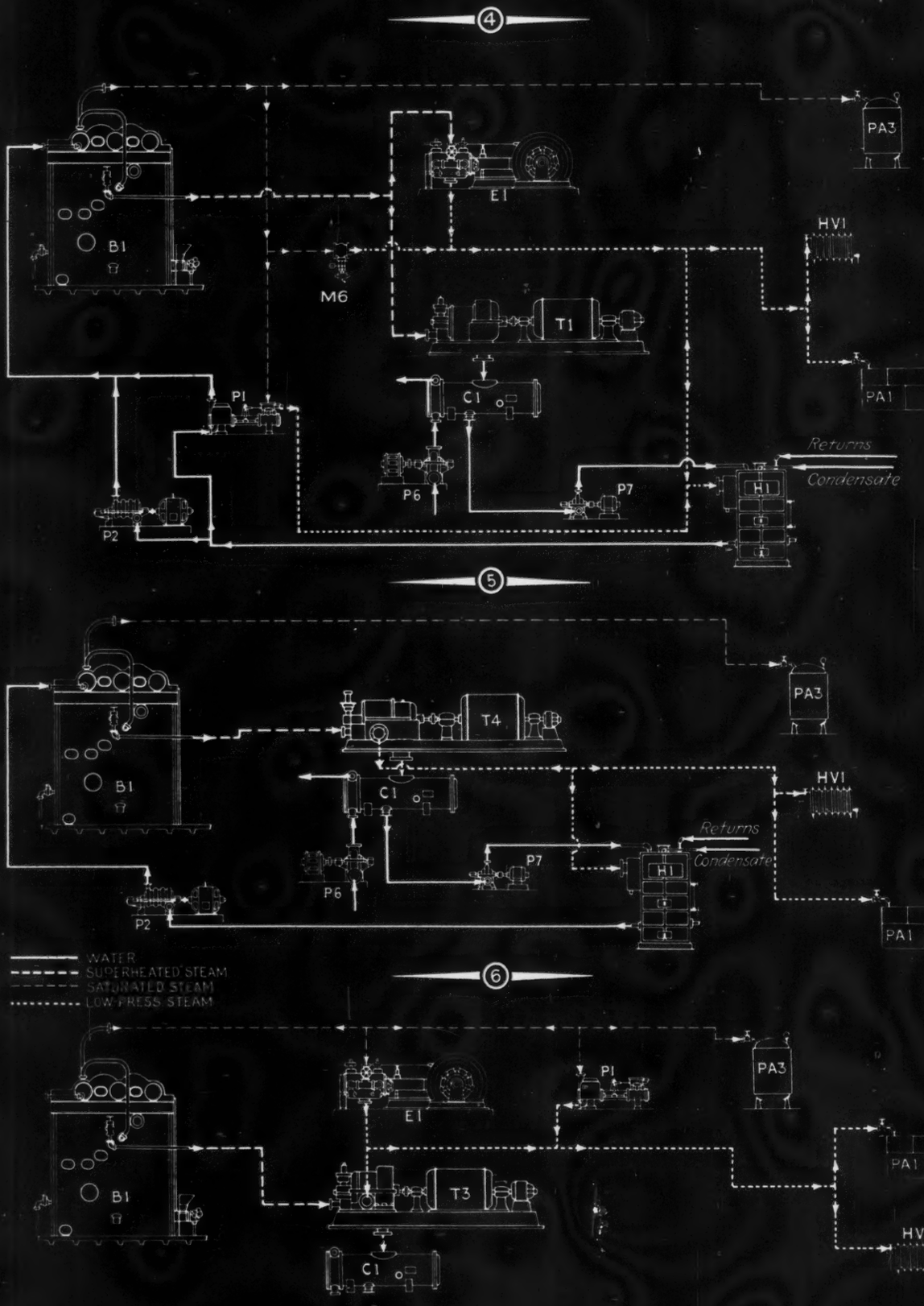

B1—Boiler
C1—Surface Condenser
E1—Steam Engine
H1—Open Heater
HV1—Heating
M6—Reducing Valve
P1—Steam-Driven Aux.
P2—Motor-Driven Pump
P6—Circulating Pump
P7—Condensate Pump
PA1—Low-Press. Process
PA3—High-Press. Process
T1—Condensing Turbine
T3—Mixed-Press. Turbine
T4—Bleeder Turbine

STEAM POWER AND PROCESS

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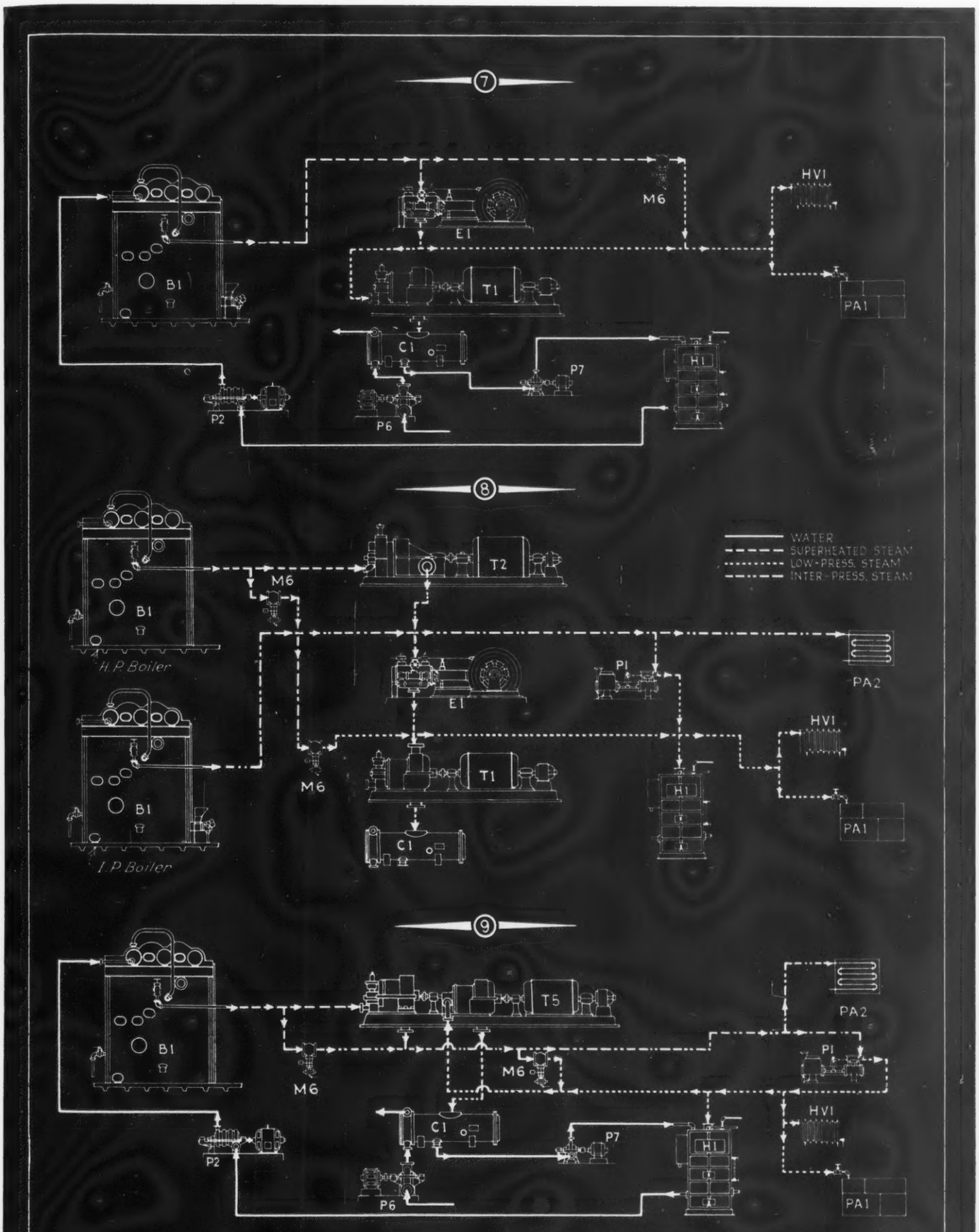

B1—Boiler
C1—Surface Condenser
E1—Steam Engine
H1—Open Heater
HV1—Heating
M6—Reducing Valve
P1—Steam-Driven Aux.
P2—Motor-Driven Pump
P6—Circulating Pump
P7—Condensate Pump
PA1—Low-Press. Process
PA2—Intermed.-Press. Process
T1—Condensing Turbine
T2—Back-Press. Turbine
T5—Double-Cylinder Turbine

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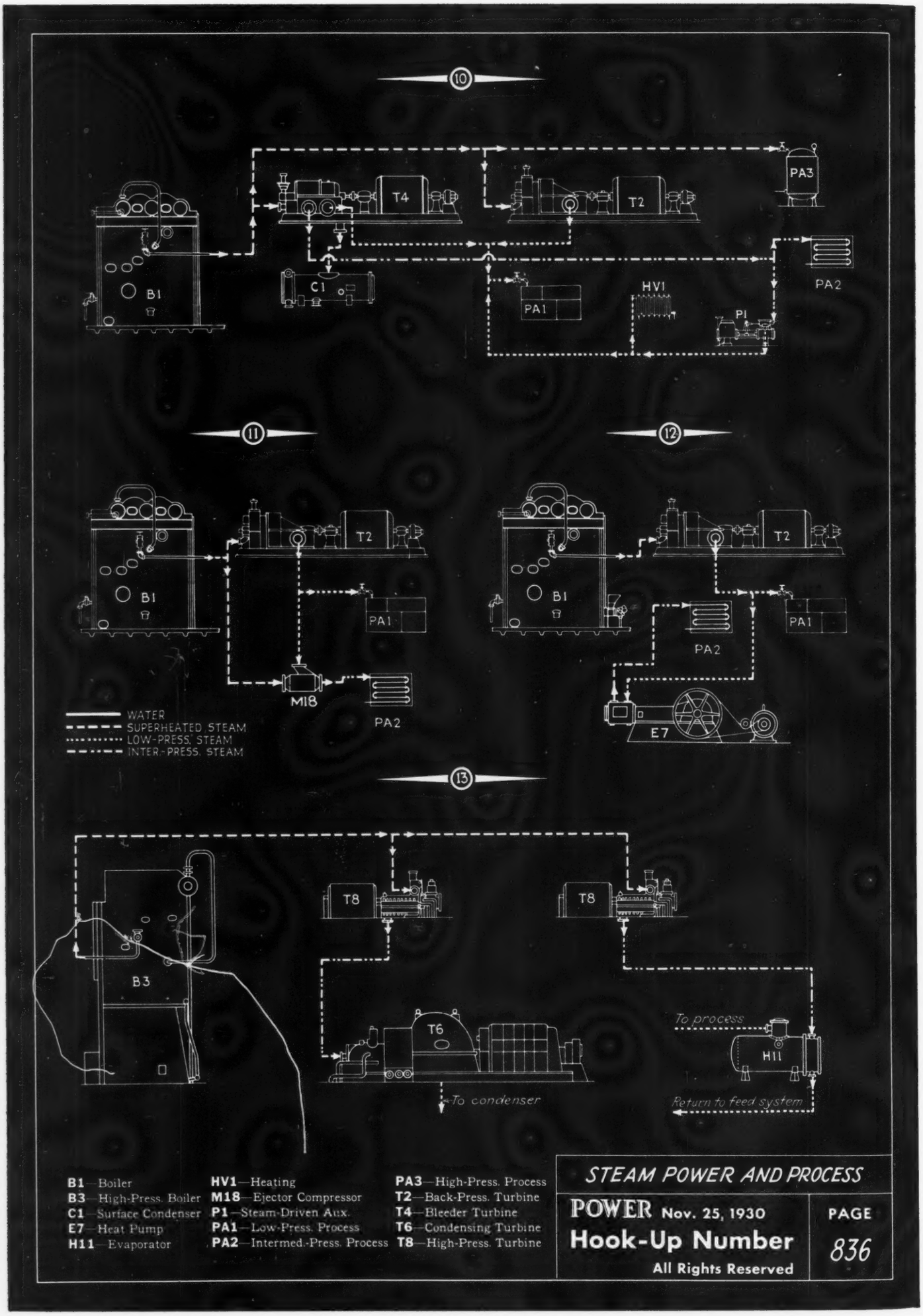

B1—Boiler
B3—High-Press. Boiler
C1—Surface Condenser
E7—Heat Pump
H11—Evaporator
HV1—Heating
M18—Ejector Compressor
P1—Steam-Driven Aux.
PA1—Low-Press. Process
PA2—Intermed.-Press. Process
PA3—High-Press. Process
T2—Back-Press. Turbine
T4—Bleeder Turbine
T6—Condensing Turbine
T8—High-Press. Turbine

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Waste-Heat Utilization

WASTE HEAT recovery in the usual sense is illustrated by hook-up 4. Hook-ups 1, 2 and 3, while examples of the generation of by-product power from process heat, may be looked upon as the recovery for water heating purposes of waste heat from the exhaust of turbines and engines. Water may be heated in one or several stages. Heating of feed water in stages permits more power to be generated from a given amount of steam produced for water heating and general process work. If, however, all power demands can be produced with single-stage water heating, and without wasting steam to atmosphere or condenser, multiplestage heating saves no fuel and is, therefore, not economically justified.

1

Description: Water heated in single stage by steam after expansion in turbine from boiler pressure to that of low-pressure process.

Application: The usual method of water heating in industrial plants.

2

Description: Water heated in two stages by steam bled and exhausted from turbine supplied with steam at boiler pressure.

Application: Where very large quantities of hot water are required, and where maximum generation of by-product power is desirable.

Remarks: Additional power (over 1) is obtained by expanding part of steam to a lower pressure.

3

Description: Water heated in three stages; first, in jet condenser taking exhaust of steam turbine; second, in surface condenser taking exhaust of steam engine; and, third, in heater taking exhaust of steam pumps and other steam-driven auxiliaries.

Application: Growth of an old plant with increasing demand for power may make such an arrangement economical.

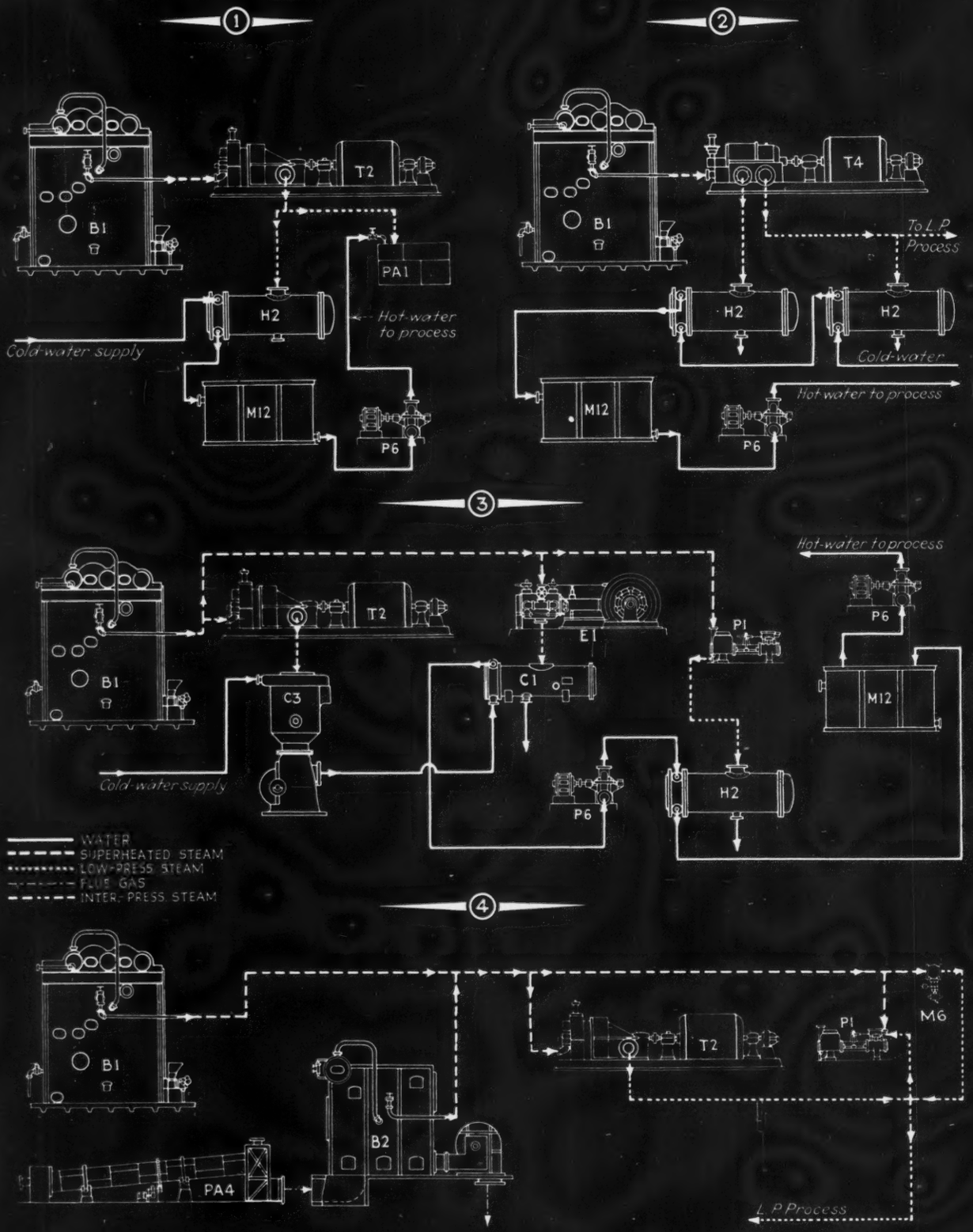
Remarks: In general, the arrangement shown would be too expensive and complex to justify itself economically, at least in a new plant. Surface condenser is used on engine exhaust, and closed heater on auxiliary exhaust, to avoid contaminating hot water with oil.

4

Description: Waste-heat boiler in parallel with existing steam boiler supplying steam to turbine and to steam manufacturing and power house auxiliaries.

Application: In cement mills, steel mills, coke plants and other places where large amounts of waste heat in process gases are available.

Remarks: An economizer may be added to waste-heat boiler. In waste-heat plants the supply of waste heat may not coincide with the demand for power. This may throw extreme fluctuations on the fuel-fired boiler and require much additional capacity there. This excess capacity and these fluctuations may be greatly reduced by the use of a steam accumulator, as shown in the accumulator section (page 839).



B1—Boiler
B2—Waste-Heat Boiler
C1—Surface Condenser
C3—Jet Condenser
E1—Steam Engine
H2—Closed Heater
M6—Reducing Valve
M12—Storage Tank
P1—Steam-Driven Aux.
P6—Circulating Pump
PA1—Low-Pressure Process
PA4—Waste-Heat Source
T2—Back-Press. Turbine
T4—Bleeder Turbine

WASTE-HEAT UTILIZATION

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Steam Storage and Electric Boilers

THE steam accumulator is a pressure vessel containing water arranged to absorb or evolve steam as the pressure rises and falls, thus acting as a "flywheel" for steam. The accumulator in most installations serves three main purposes: First, to reduce the required boiler capacity; second, to permit more even operation of the boilers with resulting higher efficiency; and third, (where by-product power is generated) to permit the maximum generation of such power, or, conversely, the maximum utilization of exhaust steam, where steam and power loads do not correspond.

The regulating valve shown in all of the hook-ups is controlled from the points to which it is connected by the light dotted lines. Control point before valve makes valve act as an overflow to keep the higher pressures from rising. Control point beyond valve makes it act as reducing valve maintaining lower pressure.

1

Description: Simple process-steam plant with accumulator supplying the low-pressure process.

Application: Where process demand fluctuates widely and no power is generated.

Remarks: A single accumulator connected to the line supplying low-pressure process also provides indirectly for fluctuations in the demand for intermediate-pressure process.

2

Description: Accumulator floating on the boiler line delivers steam through reducing valve to steam receiver and hoisting engine.

Application: For mine hoists and other installations where steam demand of power unit fluctuates violently for short periods.

Remarks: Insures steady pressure on hoisting engines or other steam-consuming apparatus and permits smaller boiler capacity.

3

Description: Turbine expands steam from boiler pressure to intermediate process pressure. Accumulator is attached to line conveying steam from intermediate process pressure to low-pressure process and heating. Plant auxiliaries expand from intermediate process pressure to low pressure.

Application: Where power demands are relatively small.

Remarks: Steam flow through turbine controlled by power demand only. At off peaks the only steam required is that for power generation.

4

Description: Boiler steam passes to turbine, which bleeds to intermediate-pressure process and exhausts to low-pressure process. Accumulator is connected between low-pressure and intermediate pressure.

Application: Where desired to salvage maximum by-product power from process steam.

5

Description: One turbine expands from high pressure to intermediate pressure; another from intermediate pressure to low pressure. Accumulator works between intermediate pressure and low pressure.

Application: Where high-pressure addition is superimposed upon old low-pressure plant. Low-pressure boilers, if retained, would be connected to I. P. process-pressure line.

Remarks: Conserves investment in low-pressure plant and increases load factor of high-pressure plant.

6

Description: High - pressure boiler supplies turbine bleeding to intermediate pressure and low pressure and exhausting to condenser. Intermediate-pressure boiler supplies turbine exhausting to condenser; also steam auxiliaries exhausting to low pressure. Accumulator works in the range between intermediate pressure and low pressure.

Application: Where a high-pressure plant is superimposed on old low-pressure plant.

7

Description: One turbine expanding steam from high-pressure line to intermediate pressure; another turbine expanding from high-pressure line to low pressure; accumulator working between intermediate and low pressures.

Application: Where all power can be generated from process steam.

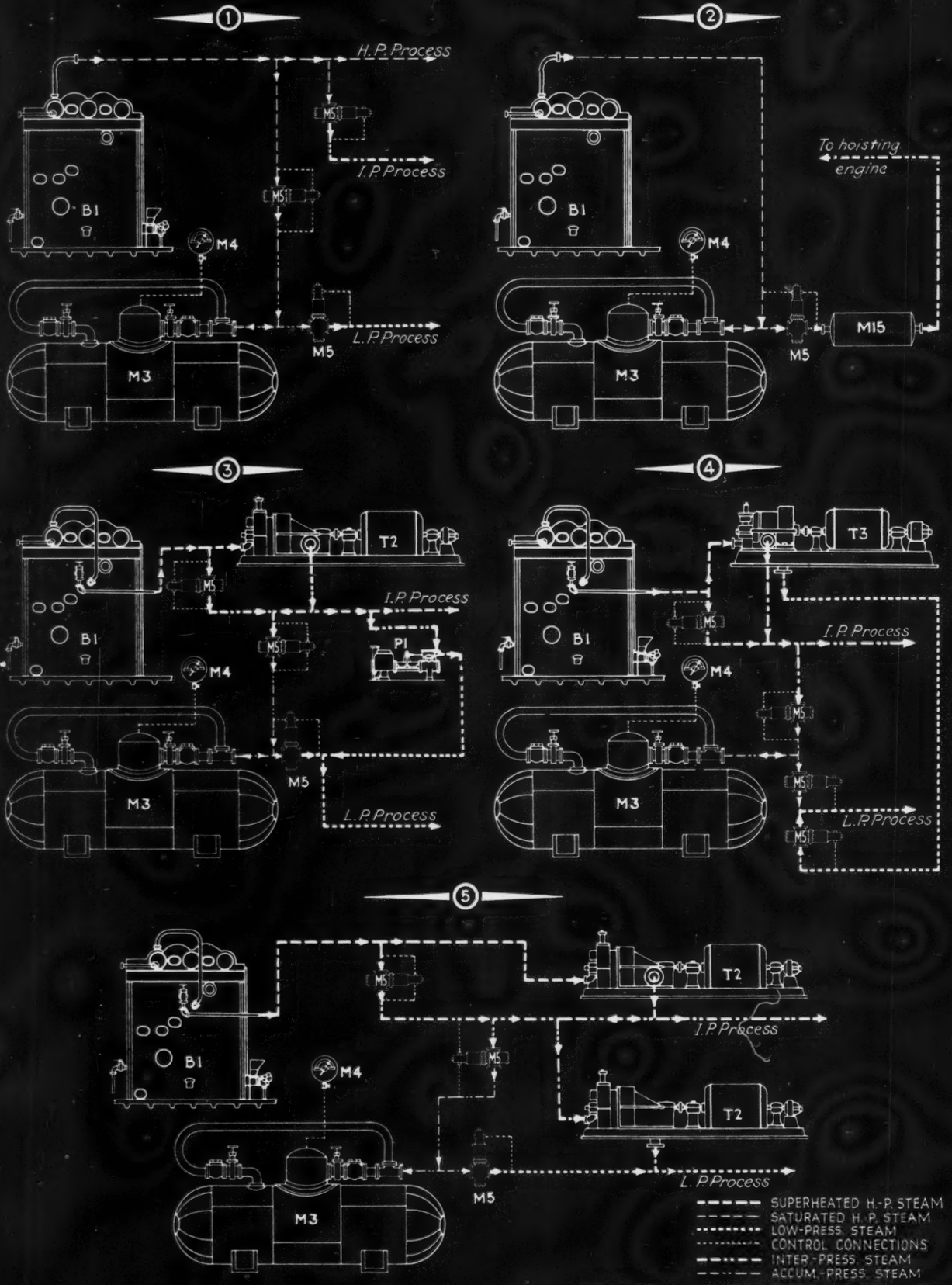
Remarks: Gives balance of power and process. "Through" connection accumulator gives desuperheated steam for low-pressure process.

8

Description: Electric boiler accumulator installation.

Application: Where electricity is available at a very low price—not greatly exceeding the B.t.u. cost of available fuel.

Remarks: Since about 300 kw.-hr. is required to generate 1,000 lb. of steam, electric boiler cannot ordinarily be considered for use if electricity is generated from fuel. It has, however, economic application to absorb large blocks of dump hydro-electric power for which there is no immediate market. Excess hydro power available at night or during flood periods may be economically used in electric boilers. Generally an accumulator should be used with the electric boiler to adjust the supply to the demand.



B1—Boiler
M3—Accumulator
M4—Master Gage
M5—Regulating Valve
M15—Receiver
P1—Steam-Driven Aux.
T2—Back-Pressure Turbine
T3—Bleeder Turbine

STEAM STORAGE

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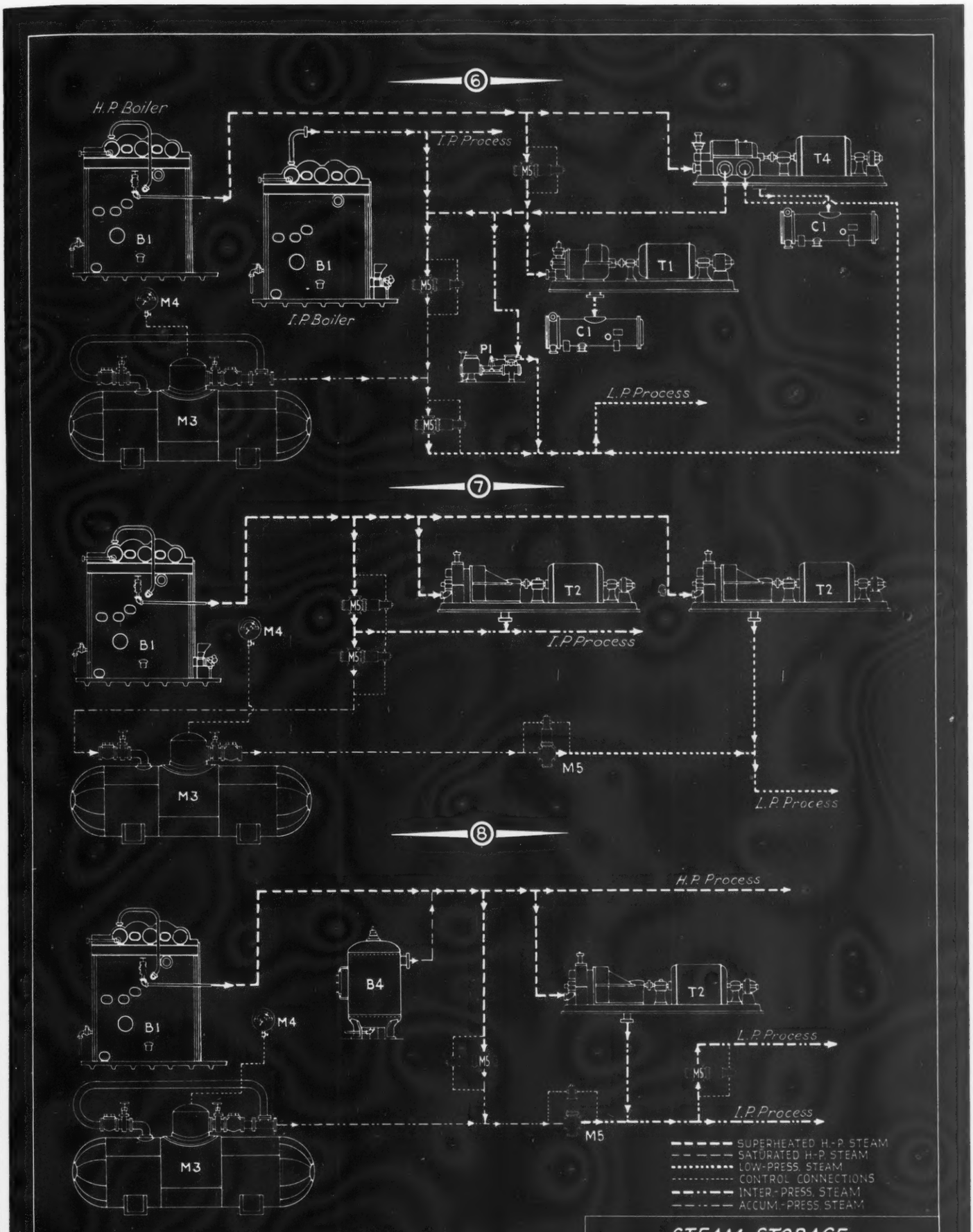

B1—Steam Boiler
B4—Electric Boiler
C1—Condenser
M3—Accumulator
M4—Master Gage
M5—Regulating Valve
P1—Steam-Driven Aux.
T1—Condensing Turbine
T2—Back-Pressure Turbine
T4—Bleeder Turbine

STEAM STORAGE

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Diesel Power—With Steam Combinations

DIESEL hook-ups here shown range from the simplest to the more complex, the former being more typical of current practice. The more elaborate hook-ups will suggest other possible arrangements not here shown. While heat-recovery arrangements are shown in the later diagrams, it should not be inferred that failure to salvage heat from exhaust and cooling water of a diesel engine represents a loss comparable to that in the atmospheric or condensing exhaust of a steam engine or turbine of equal power. For a given power output the diesel receives and rejects less heat. However, methods and equipment for conserving waste heat are available wherever economic conditions justify their use.

1

Description: Simplest type of oil-engine plant. Fuel is taken from the storage tank by a pump and delivered to the engine supply tank. Cooling water is taken from an existing water supply, and the discharge is wasted.

Applications: Used chiefly in small-capacity plants.

Remarks: Cheap to install.

2

Description: Same as 1, plus water storage tank and a cooling tower.

Applications: Suitable arrangement for typical small plant.

Remarks: Addition of cooling tower permits the water to be re-used, thereby reducing the cost item. Storage tank insures a constant supply of water, so engine can be cooled after shutdown. Also insures against pump trouble.

3

Description: Similar to 2, but with heat recovery and water treatment.

Applications: Chiefly in factories where a more economical source of warm water is not available.

Remarks: Part of the warm jacket water is passed through the exhaust heater to raise its temperature so it may be used in the factory. Water softener insures scale-free make-up water to replace that used in the factory. Where the fuel oil is clean, the fuel arrangement is satisfactory.

4

Description: Similar to 3, but with filtered fuel and lubricating oil.

Application: Where low-grade oils are used and heat recovery is worthwhile. If the difference in price dictates the use of a low-grade fuel oil, installation of the centrifuge is advisable.

Remarks: Part of the cooling water passes to an exhaust heater, for subsequent use in the feedwater heater of the steam end of the plant. The recovery of part of the jacket and exhaust heat enables a high-temperature feed to be supplied to the boilers in the plant. The raw water must be non-scale forming.

5

Description: Closed cooling-system hook-up.

Application: Where water is bad, and the plant too large to treat the large make-up of an open system, the closed-cooling system is desirable.

Remarks: Part of this water may be put through an exhaust heater, as shown, in which event the water-treating system must have a large capacity. This hook-up introduces the closed cooling system, in which the jacket water is cooled by a supply of raw water. On the assumption that the fuel is high grade, no centrifuge is shown; on the other hand, the lubricating oil is continuously clarified.

6

Description: Air-heater used to recover waste heat for process use.

Application: This system is applicable where large amounts of warm air are needed.

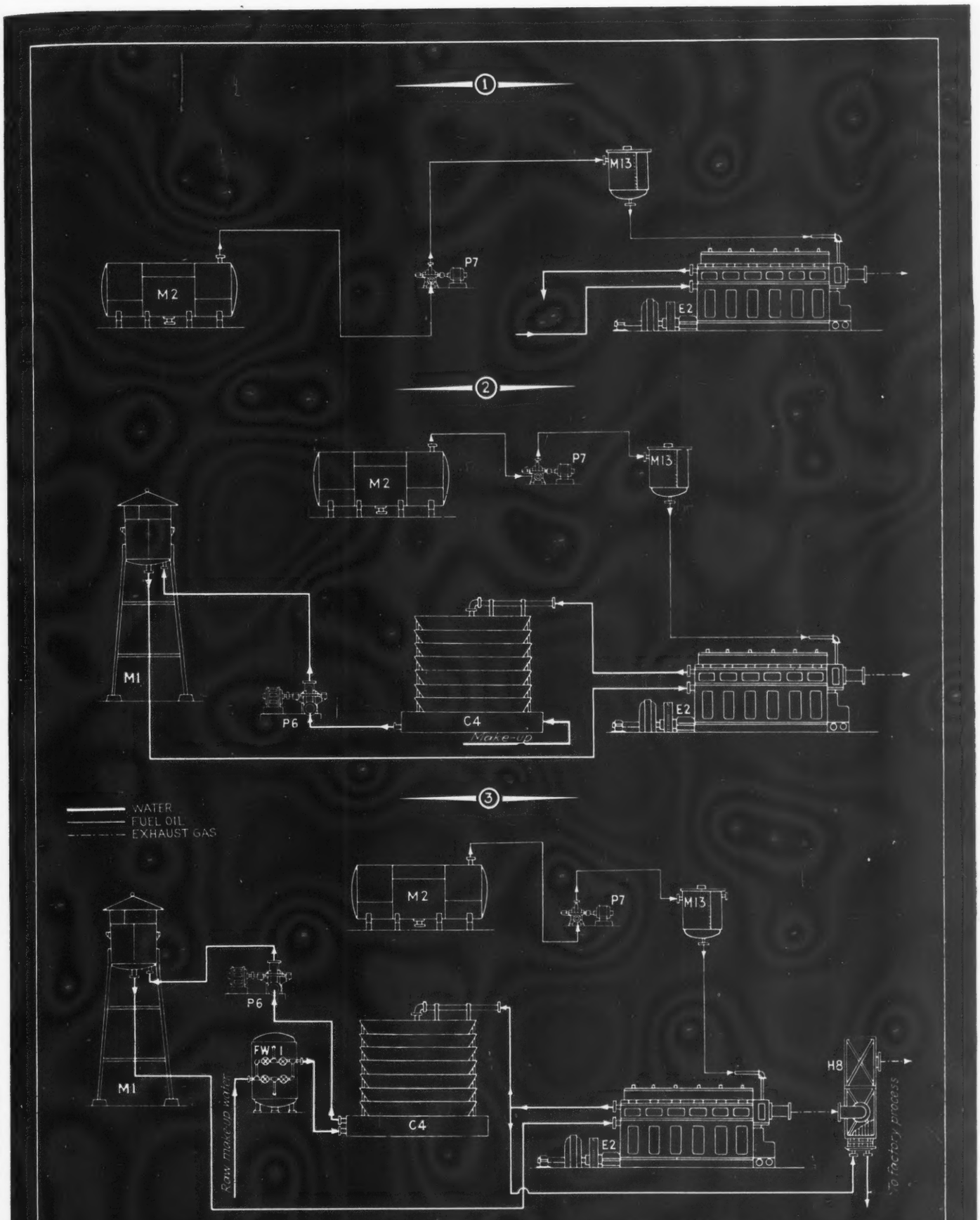
Remarks: The jacket water is cooled by air from a fan, which air is further heated by the exhaust gases before being forced to processes, such as brick drying. On the basis that the raw water is bad, a water-treating system is shown.

7

Description: Steam-oil hook-up.

Application: This arrangement has application only for such special high-economy installations as the Scott-Still marine drive. However, the system is sometimes used when modified so that the low-pressure steam is used for heating.

Remarks: This hook-up embodies the combination of an oil engine and a steam turbine. The fuel oil used is heavy and so calls for heating by part of the jacket water and a subsequent centrifuging. Part of the jacket water is passed to an exhaust boiler where low-pressure steam is generated for use in a low-pressure turbine. This is essentially the Scott-Still oil-steam system. The cooling system is closed, with the make-up treated. As the plant is large, the lubricating oil is cooled before it is returned to the engine.



C4—Cooling Tower **H8**—Heat Exchanger **M13**—Tank
E2—Diesel Engine **M1**—Tower Tank **P6**—Pump
FW1—Water Softener **M2**—Storage Tank **P7**—Pump

DIESEL POWER

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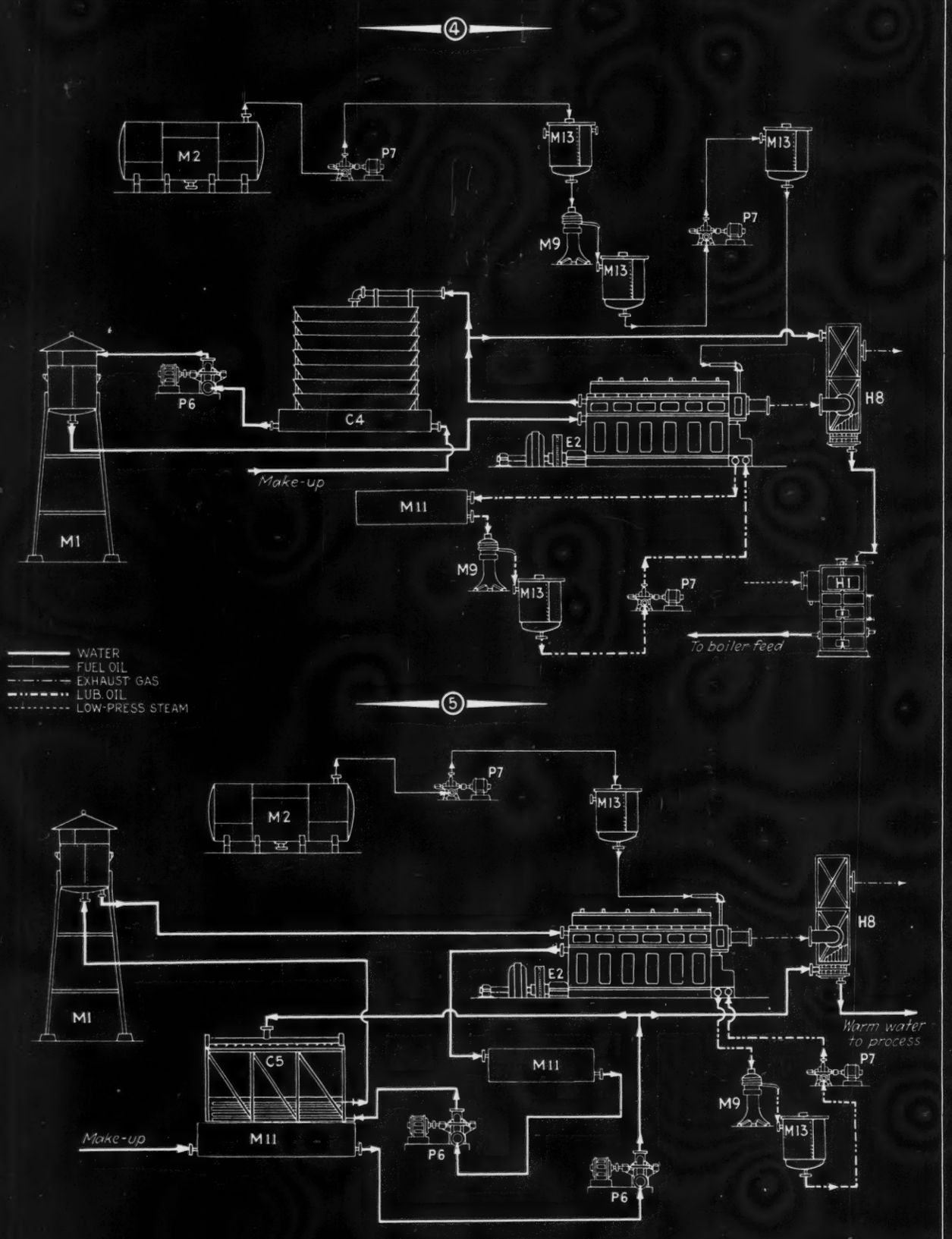

C4 Cooling Tower
C5 Spray Cooler
E2 Diesel Engine
FW1 Water Softener
H1 Open Heater
H8 Heat Exchanger
M1 Tower Tank
M2 Storage Tank
M9 Centrifuge
M11 Sump
M13 Tank
P6 Pump
P7 Pump

DIESEL POWER

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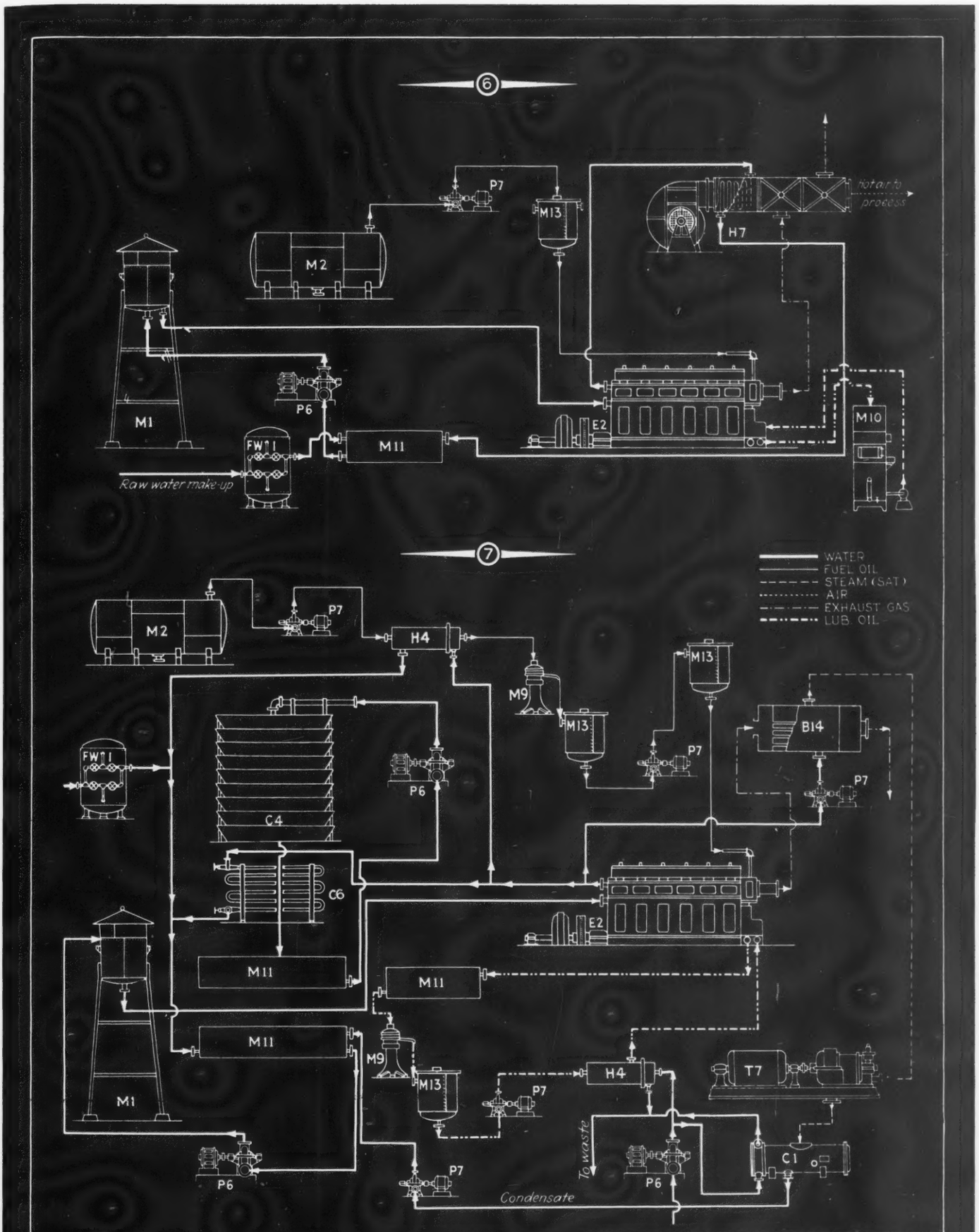

B14 Exhaust Boiler
C1 Surface Condenser
C4 Cooling Tower
C6 Cooling Coil
E2 Diesel Engine
FW1 Water Softener
H4 Oil Heater
H7 Heat Exchanger
M1 Tower Tank
M2 Storage Tank
M9 Centrifuge
M10 Oil Filter
M11 Sump
M13 Tank
P6 Pump
P7 Pump
T7 Steam Turbine

DIESEL POWER

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Hydro Hook-Ups—Pumped Storage

HYDRO and fuel-burning power plants are interconnected under a wide variety of local conditions. There are certain fundamental interconnections, indicated in the three diagrams that follow. The hydro plants may be either high-, medium- or low-head. They may be provided with seasonal storage to regulate the flow or they may be of the run-of-river type with daily or weekly storage only. For special conditions pumped storage may be provided. Fuel-burning plants, either steam or diesel engine installations, are included, depending on local and other conditions that influence equipment selection and plant design.

1

Description: Fuel-burning and hydroelectric plants interconnected. The fuel-burning plants include steam and diesel installations while hydro represents plants of either run-of-river type or those on rivers regulated by storage reservoirs supplied by natural runoff.

Application: Where hydro and fuel-burning plants exist within economical transmission distances.

Remarks: A group of interconnected plants can generally supply a given district more economically than single plants supplying parts of the territory. Load factor is usually improved and system's reliability increased. Smaller percentage of reserve capacity is required to insure reliable operation with an interconnected system. With hydro plants on the system, a smaller running- or hot-reserve capacity is required than for steam alone. A hydro plant can be started in a few minutes, where hours are required to start a cold steam plant and put it into service. The diesel engine plant has a similar advantage over the steam plant, but where large power is required it has a disadvantage in limited size of units that can be installed. Construction costs of a hydro plant are usually higher and operating costs lower than for a steam or a diesel engine plant of same size. Run-of-river hydro plants within short transmission distance of large load centers can be built to supply daily peak loads more cheaply than other type of plant. Where hydro plants are long distances from large load centers, steam plants at load centers insure reliability of system by providing a source of power near load.

2

Description: Hydro plant operating on pumped water interconnected with other hydro plants and steam stations.

Application: In some cases where storage for the hydro system cannot be obtained from natural runoff, a combination hydro and pumped storage plant will provide desired hydro reserve on system.

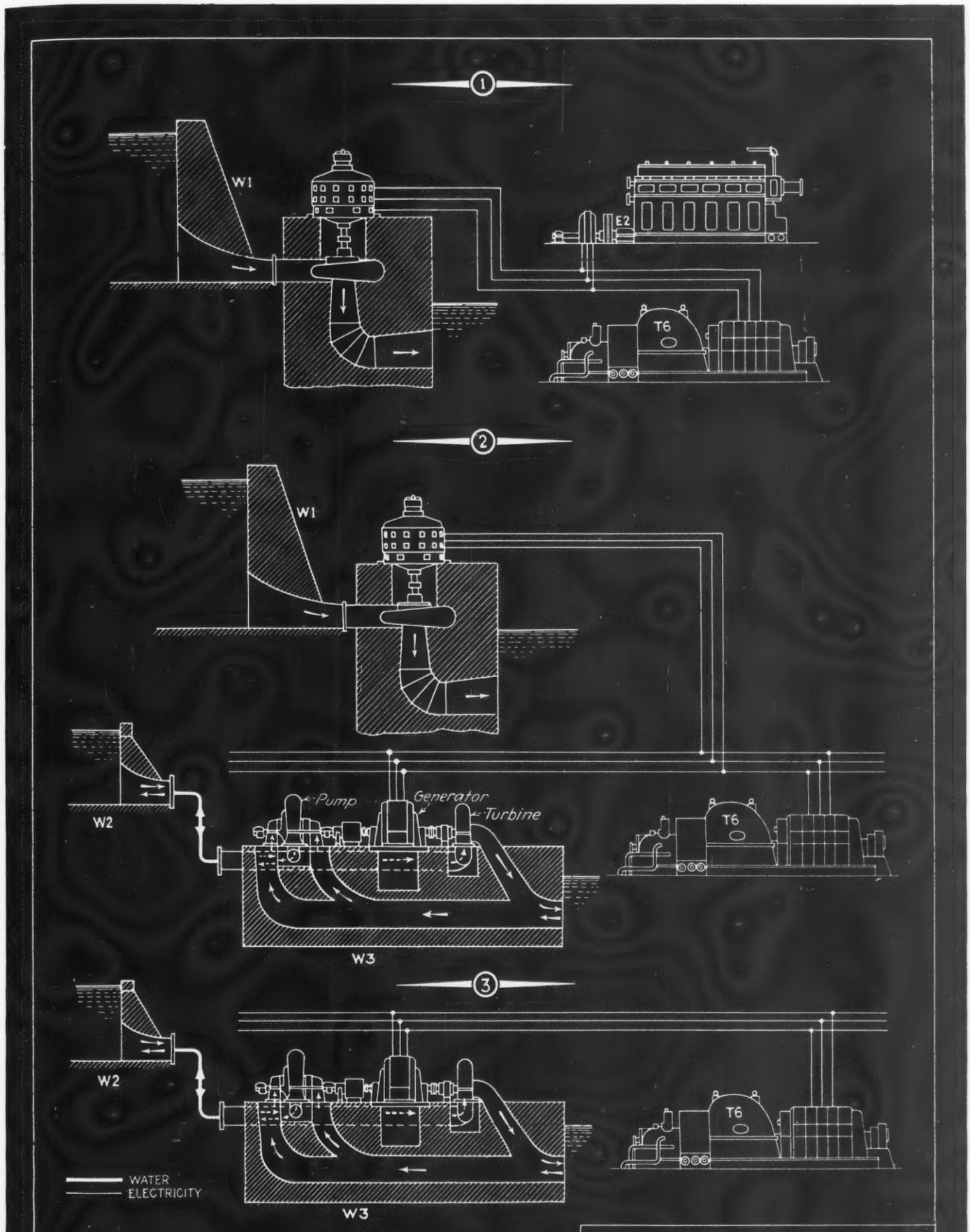
Remarks: Same comments apply as to 1. In addition a storage reservoir can be created where conditions are favorable, even if natural inflow to the reservoir is negligible, provided there exists near the reservoir site a supply of water at a lower level. Pumped storage provides an energy reserve that can be brought into service in a few minutes. Pumping is done by low-cost off-peak steam power, later to be converted into high-value peak energy. Excess hydro power from flood water of no value is used to pump storage water for use during low-water periods and to increase low flow of river. Pumped-storage systems are largely independent of rainfall and of drainage area. Water released from storage to meet emergencies can be replaced by pumping, a feature not present with reservoirs depending on drainage.

3

Description: Pumped storage hydroelectric plant interconnected with steam system.

Application: To utilize low-cost off-peak power to pump water into a storage reservoir for use in a hydro-electric unit to supply high-value daily peak power. Has been applied where a reservoir site was available near a water supply fairly close to large load centers.

Remarks: The pumped storage is intended chiefly to supply daily peaks and improve load factor of steam plants, although it provides a quickly available emergency power source. High cost of the system and cost of power used for pumping are most serious objections to pumped storage. In 2 a large part of the power used for pumping may be excess hydro and therefore has no value. Using this power for pumping water provides seasonal and daily storage at low cost compared with a system where all pumping is done with energy from fuel-burning plants.



E2—Diesel Engine
T6—Steam Turbine
W1—Hydro-Electric Unit
W2—Storage Reservoir
W3—Hydro-Electric Unit and Pump

WATER POWER

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Ash-Handling Diagrams

WHERE it is possible to handle both coal and ash with one conveyor a saving can usually be made in the first cost of plant. The use of one system for handling both materials, however, is not always practicable owing to the abrasive character of the ash. Where ash must be conveyed long distances or where a large quantity must be handled daily, systems that convey the ash in liquid condition offer certain advantages. On the following page are shown some of the hook-ups now in general use. Typical conveying systems handling both coal and ash are shown in hook-ups 3 and 5 of the succeeding article on coal handling.

1

Description: Steam-pneumatic and steam-jet ash conveying hook-ups.

Application: To new and existing boiler plants, particularly where space is limited.

Remarks: In the steam-pneumatic system shown at the left, a vacuum is produced in a receiver which is sealed from the ash hopper, the ash being dumped periodically from the receiver to the hopper with the steam-air exhauster shut off. With this system the ash is handled dry.

2

Description: Ashes handled on lower run of slowly moving drag chain.

Application: In small and moderate-sized plants where ashes can be conveyed horizontally or with slight incline to elevator, skip hoist or other conveying unit.

3

Description: Ashes drawn from pit to sluiceway and conveyed by high-pressure water jets. Then delivered to storage or fill by centrifugal motor-driven pump.

Application: Used with both stoker- and pulverized-fuel-fired furnaces. Particularly applicable where ashes must be conveyed long distances—for example, to fill in lowlands adjacent to plant.

Remarks: This system permits minimum headroom between boiler operating floor and basement floor.

4

Description: Ashes conveyed hydraulically from boiler to sump.

Application: Used in large plants where constant removal of ash from boilers is desirable.

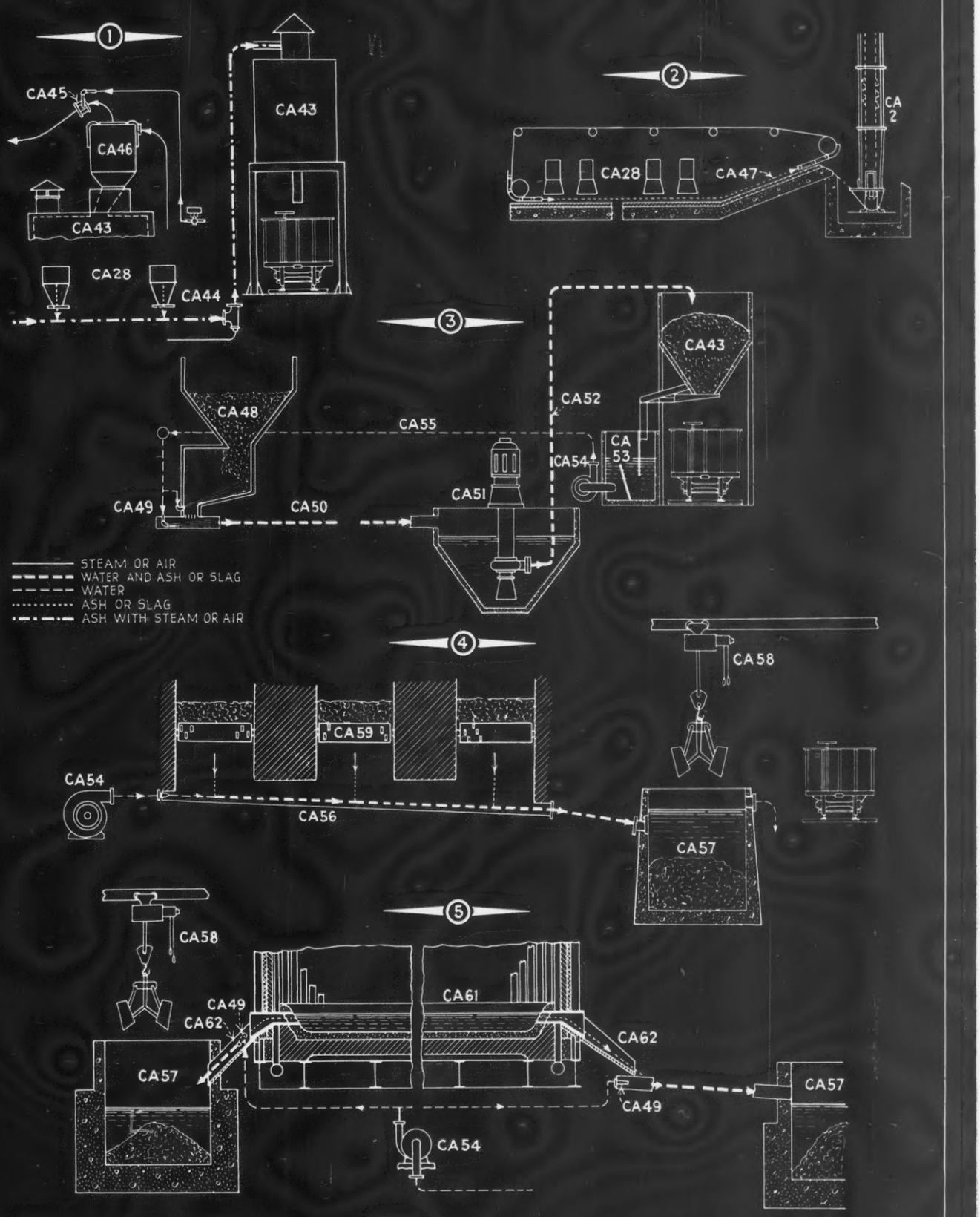
Remarks: Ashes drop directly from clinker rolls into sluiceway. This system eliminates the use of ashpit below each boiler and the use of quenchers.

5

Description: Alternate methods of tapping off slag from bottom of furnace.

Application: Used with pulverized-fuel-fired furnaces normally operating at high ratings.

Remarks: In the tapping arrangement shown at the left water is admitted to the slag spout to chill and to shatter the slag before it reaches the tank. Slag lifted from tank by clam shell. In the arrangement shown at the right a high-pressure water jet is used to chill and break up the slag after it drops from the spout. With this system the slag can be conveyed some distance from boiler or sump or to lowlands or other points of disposal.



CA2—Bucket Elevator
CA28—Ash Gates
CA43—Ash Hopper
CA44—Steam-Jet Conv.
CA45—Steam-Vac. Conv.
CA46—Receiver
CA47—Drag Chain
CA48—Ashpit
CA49—Water Jet
CA50—Trench
CA51—Ash Pump
CA52—Pump Discharge
CA53—Clear-Well Tank
CA54—Water Pump
CA55—Recirc. Line
CA56—Ash Sluice
CA57—Ash Sump
CA58—Bucket and Hoist
CA59—Clinker Rolls
CA60—Furnace
CA61—Slag Bottom
CA62—Slag Spout

ASH HANDLING

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Coal Handling and Preparation

FROM the many different types of coal- and ash-handling equipment now available, a system can be selected to meet satisfactorily any requirement of the small or large plant from the simplest mono-rail-bucket hoist of small capacity to the most extensive system of several hundred tons an hour capacity. The hook-ups shown on the first three following pages are only a few of the many combinations possible. It is, of course, impossible to include all the different types of equipment available for this service. Two of the systems (3 and 5) handle both coal and ash. Separate ash-handling systems were shown on page 849. Various methods of connecting pulverized-fuel equipment are given on page 854.

1

Description: From car to portable conveyor, to plant.

Application: Used in small and moderate sized plants.

Remarks: Conveyor can also be used to store coal in bin or pile adjacent to plant. When used with power-driven unloader coal is transported direct from car to boiler room or storage pile.

2

Description: Car hopper to feeder, to crusher, to elevator, to silo, to hopper, to furnace.

Application: In small and moderate-sized plants where storage can be limited to capacity of silo.

Remarks: When live storage above baffle in silo is full coal overflows to dead storage. Coal is transferred from dead to live storage by operating elevator. Sketch shows application to vertical-jet crushed-coal furnace.

3

Description: Single-bucket conveyor arranged to handle both coal and ash.

Application: Where arrangement of boilers makes possible handling of the coal and ash with one conveying unit.

Remarks: Ash hopper is placed directly above coal-unloading hopper and same car may be used for both coal and ash.

4

Description: From storage pile and locomotive crane to hopper, or from car to hopper; then to crusher, to elevator, to bunker, to weigh larry, to boiler.

Application: Where storage must necessarily be some distance from plant and where coal has to be unloaded from barge to railway cars for transportation to plant.

Remarks: Permits storing large quantities and use of standard cars and unloading facilities when reclaiming.

5

Description: To skip hoist from storage by drag scraper, or direct from car hopper to skip hoist; then to overhead hopper; from overhead hopper to storage; or from overhead hopper to crusher, to bunker, to boiler.

Application: Used where large area is available for coal storage adjacent to plant.

6

Description: From car in rotary car dumper, to hopper, to conveyor, to main breaker, to belt conveyor, over magnetic pulley to bucket conveyor, to flight conveyor, to bunker, to pulverizer, to boiler.

Application: In plants of large capacity where most of coal used can be handled directly to boiler room.

7

Description: Car hopper to skip hoist, to hopper in tower; also from barge to clam shell bucket, to hopper in tower. From tower hopper to scale and feeder, to crusher, to belt conveyor, to distributing belt, to bunker, to weigh larry, to boiler.

Application: Where coal is received by railroad and barge.

8

Description: Pulverized-coal preparation and firing system with exhauster placed on return side of cyclone. Vented air from cyclone goes to primary-air fan. Preheated air used as secondary air to the furnace and for drying in the mill.

Application: In larger plants where, owing to the large amount of coal consumed or other operating conditions, it is desirable to use mills of large capacity and a preparation plant independent of the firing system.

Remarks: With exhauster placed on return side of cyclone, wear on exhauster rotor is reduced to a minimum and a more efficient fan can be used.

9

Description: Storage system with exhauster between mill and cyclone. Pulverized fuel conveyed to bin by transport pump.

Application: Same as 8.

Remarks: Preheated air used as primary, secondary and tertiary air. Mills used with this system are equally well adapted to direct firing with vertical or horizontal burners as shown in 10, 11, 12, or to opposed or corner firing of large steam generating units.

10

Description: Unit mill with self-contained exhauster. Boiler operating with heated primary air and cold secondary air.

Application: For direct firing of new and existing boiler installations.

Remarks: Preheated air for drying in the mill drawn from hollow furnace walls and bottom.

11

Description: Unit system with separate exhauster and steam air heater.

Application: Same as 10, with addition of steam air heater.

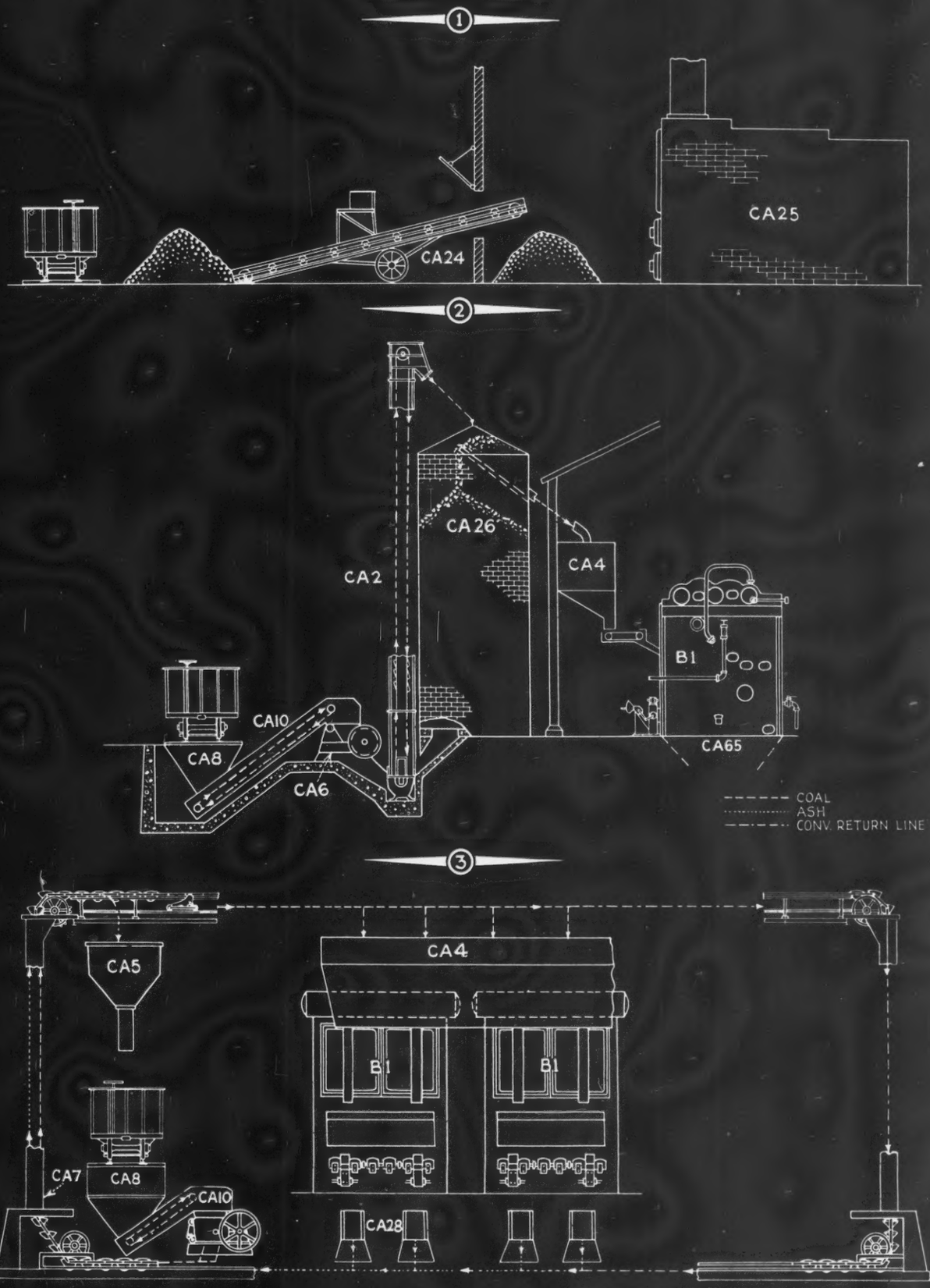
Remarks: Steam air heater used where arrangements to heat by flue gases or hollow furnace walls are not practicable with existing installation.

12

Description: Unit firing with one mill supplying three burners. Mill operating under pressure.

Application: Where space is limited. Particularly with limited headroom, as fan can be placed on same floor as pulverizer.

Remarks: Coal and air lines are taken off the top of pulverizer direct without use of distributer. As fan handles air only, maintenance is reduced and more efficient fan can be used. Preheated air used for mill drying. Tempering air admitted on inlet side of fan.



B1—Boiler
CA2—Bucket Elevator
CA4—Coal Bunker
CA5—Ash Hopper
CA6—Crusher
CA7—Bucket Conveyor
CA8—Unloading Hopper
CA10—Apron Feeder
CA24—Portable Conveyor
CA25—Boiler
CA26—Coal Silo
CA65—Vert.-Jet Furnace
CA28—Ash Gates

COAL HANDLING

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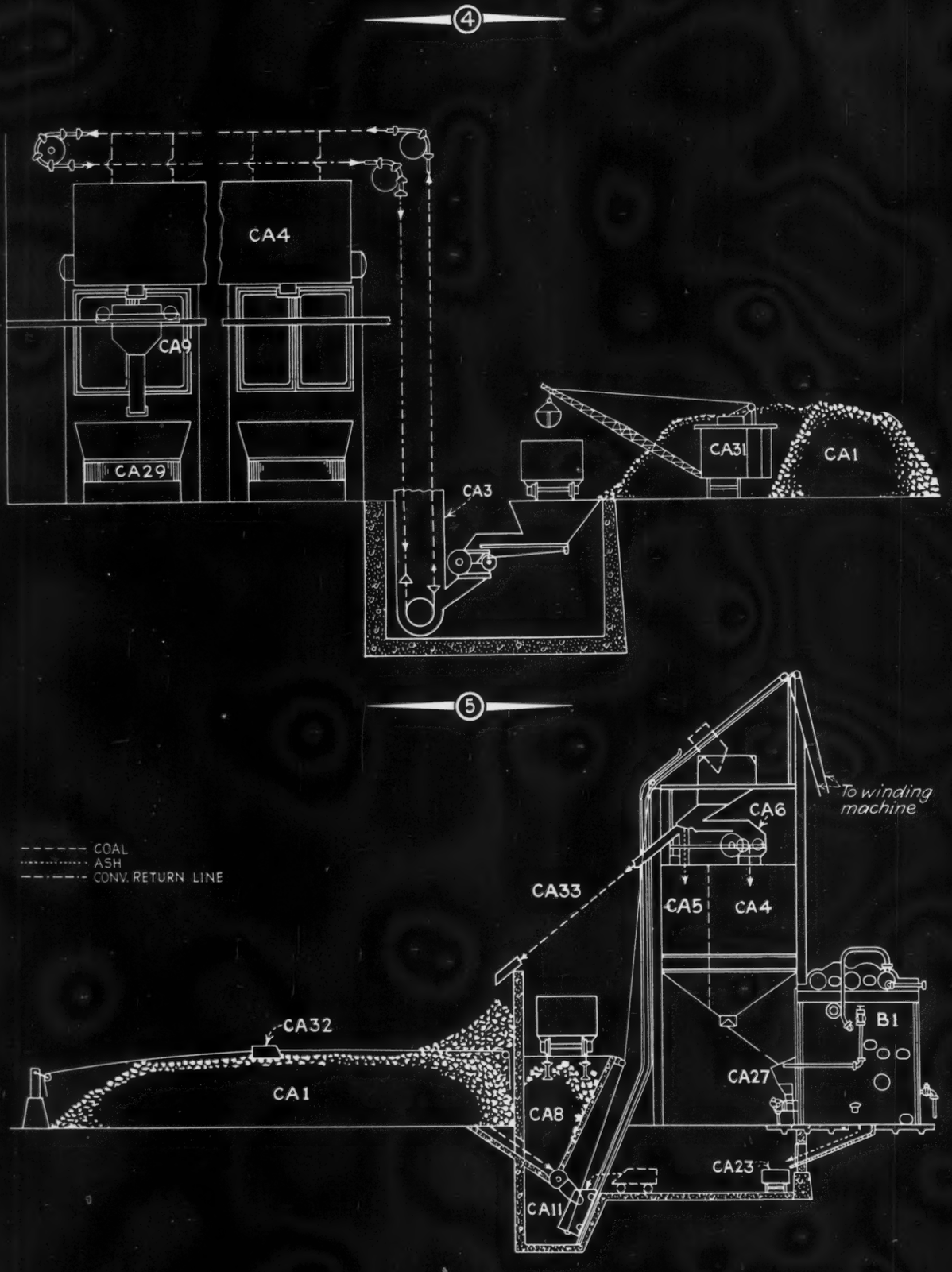

B1—Boiler
CA1—Coal Storage
CA3—Bucket Conveyor
CA4—Coal Bunker
CA5—Ash Hopper
CA6—Crusher
CA8—Unloading Hopper
CA9—Weigh Larry
CA11—Skip Hoist
CA23—Ash Car
CA27—Stoker
CA29—Stoker
CA31—Locomotive Crane
CA32—Drag Scraper
CA33—Chute to Storage

COAL HANDLING

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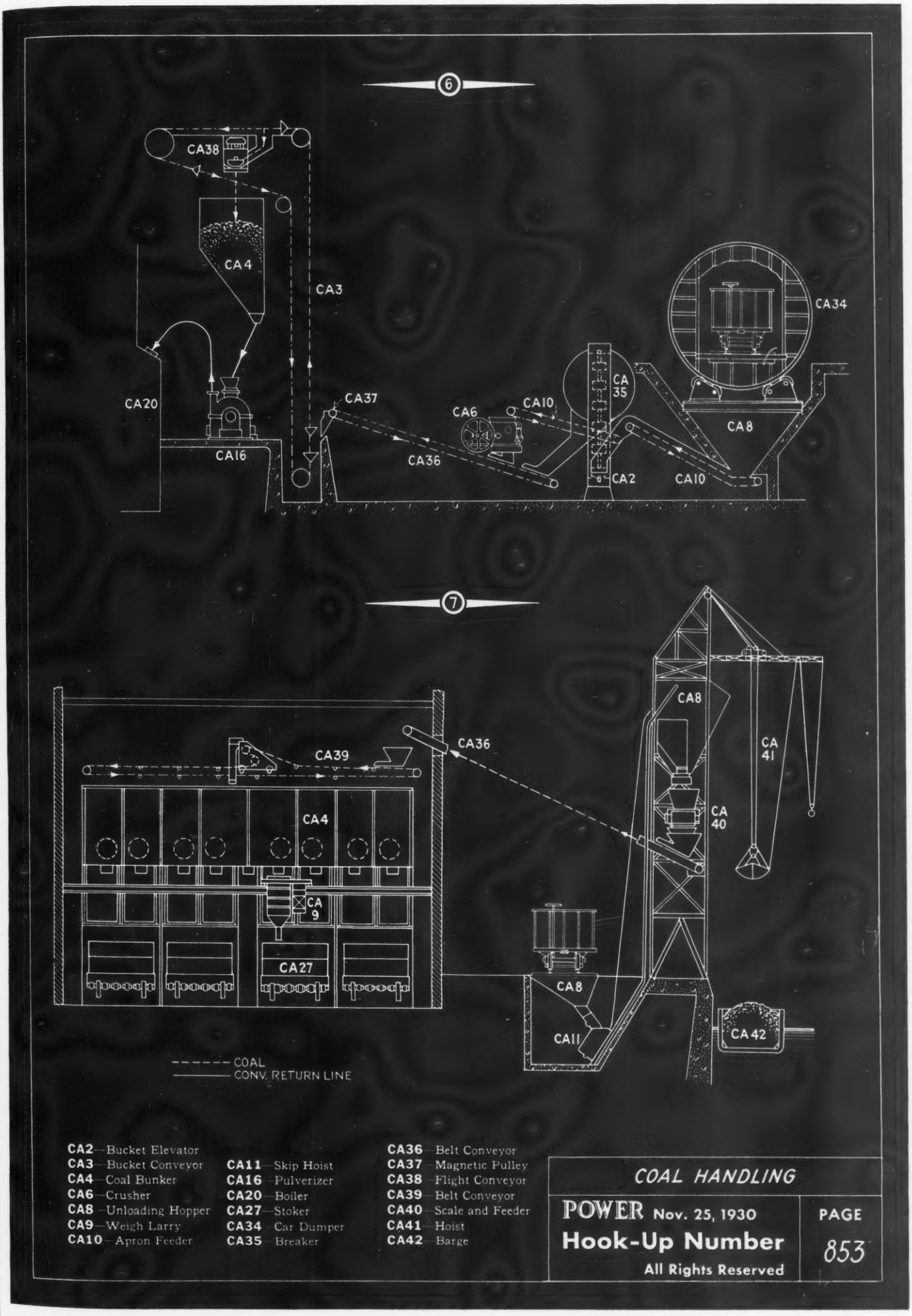

CA2—Bucket Elevator
CA3—Bucket Conveyor
CA4—Coal Bunker
CA6—Crusher
CA8—Unloading Hopper
CA9—Weigh Larry
CA10—Apron Feeder
CA11—Skip Hoist
CA16—Pulverizer
CA20—Boiler
CA27—Stoker
CA34—Car Dumper
CA35—Breaker
CA36—Belt Conveyor
CA37—Magnetic Pulley
CA38—Flight Conveyor
CA39—Belt Conveyor
CA40—Scale and Feeder
CA41—Hoist
CA42—Barge

COAL HANDLING

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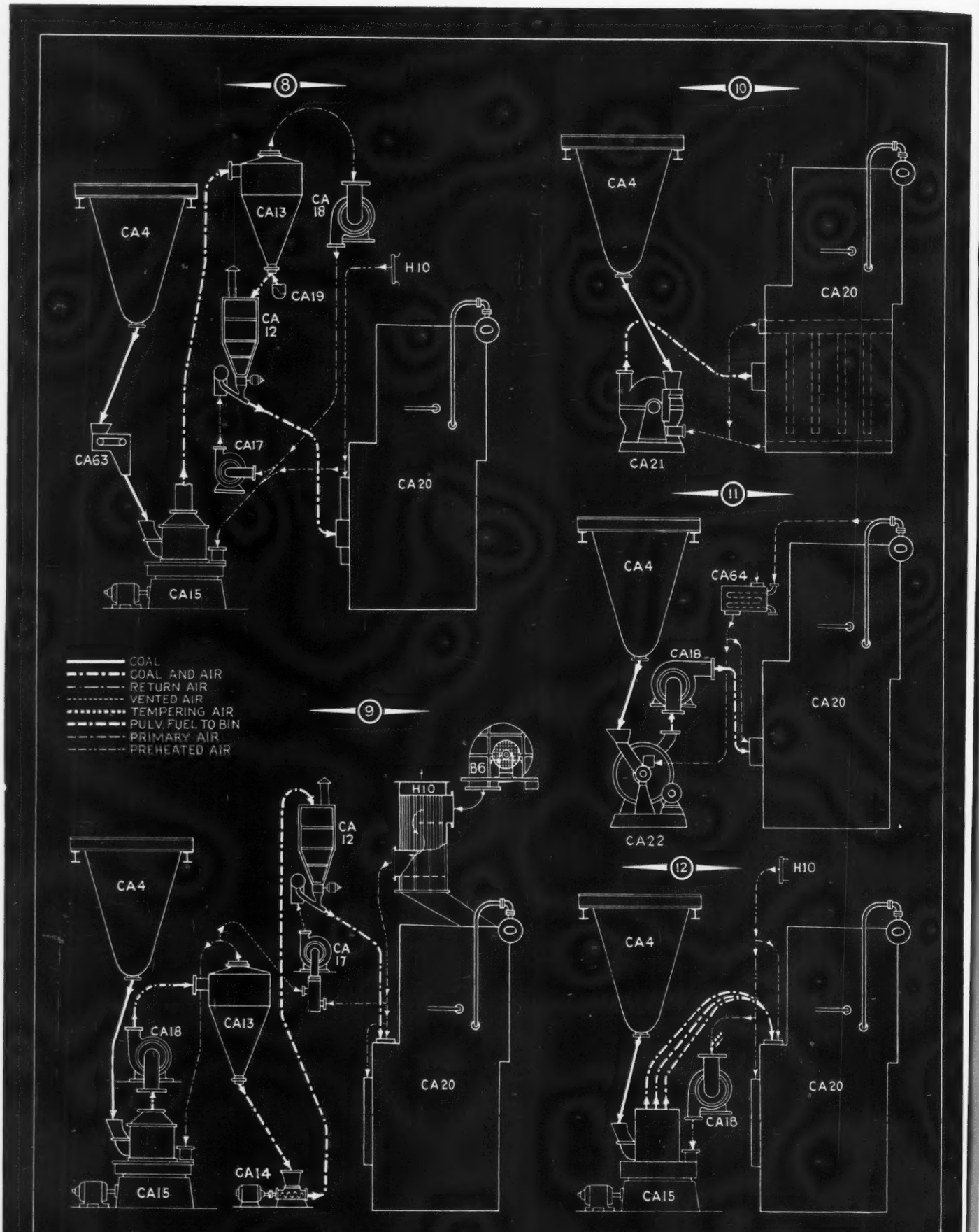

B6—Forced-Draft Fan
CA4—Raw-Coal Bunker
CA12—Pulv.-Coal Bunker
CA13—Cyclone Collector
CA14—Transport Pump
CA15—Pulverizer
CA17—Primary-Air Fan
CA18—Exhauster
CA19—Screw Conveyor
CA20—Boiler
CA21—Pulverizer
CA22—Pulverizer
CA63—Coal Scale
CA64—Steam-Air Heater
H10—Air Preheater

COAL HANDLING

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Feed-Water Treatment

HOOK-UPS shown include not only typical examples of make-up softening, but also arrangements for reducing boiler-water impurities by deconcentration and continuous blowdown. Several hook-ups show methods of recovering heat from blowdown. Others show treatment of evaporator feed and methods of adding acid to water from zeolite softener. Chemical softeners (FW3) typify either hot-process or cold-process units in which lime, soda or other reagents are added to the water. Zeolite softeners all operate by passing water through a bed of sand-like zeolites (base-exchange silicates), which replace the basic elements in hardness salts with sodium. Sodium compounds do not form scale.

1

Description: Feeder arranged to deliver chemical treatment direct to boiler.

Application: In small plants where quality of raw water does not justify more elaborate equipment. Also in modern large plants where scientific methods of boiler-water conditioning under chemical control can be applied.

Remarks: Many variations (all simple) of this scheme are in use.

2

Description: Deconcentrator with thermal-syphon circulation.

Application: Wherever desirable to remove precipitating impurities continuously to avoid their concentration in the boiler.

Remarks: Flow produced by lower temperature and greater density of outside branch of circuit. Water removed from upper boiler drum passes through deconcentrator where sludge settles out, then passes to lower drum. Will not remove soluble impurities.

3

Description: Deconcentrator with pumped circulation.

Application: Same as 2.

Remarks: Same as 2 except water is withdrawn from boiler at bottom and delivered at top. Deconcentrator of filter type is indicated.

4

Description: Simple chemical softener system.

Application: In all types of plants where raw water hardness exceeds 2 or 3 grains per gallon.

Remarks: Sand filter (FW2) removes sludge that does not settle in FW3.

5

Description: Simple zeolite softener system.

Application: In all types of plants except where raw water is acid or has a high carbonate content.

6

Description: Chemical and zeolite softeners in series.

Application: Sometimes used to further reduce hardness of water softened by chemical softener.

7

Description: Evaporator feed softened by zeolite or chemical softener.

Application: Widely used in large plants where all make-up is distilled.

Remarks: The two softening systems are presented as alternate hook-ups, not normally used together. Softened feed reduces the formation of sludge and scale in the evaporator and greatly increases the operating period between "scalings." Evaporator must still be blown down sufficiently to keep concentration below the priming point.

8

Description: Continuous blowdown with one stage of heat recovery.

Application: In all types of plants, but particularly where some undistilled make-up is used, necessitating a considerable blowdown.

Remarks: Recovers much of blowdown heat with substantial savings.

9

Description: Continuous blowdown with heat recovery in two stages (below and above temperature level of open heater).

Application: Same as 8, but where maximum heat recovery at high level is justified.

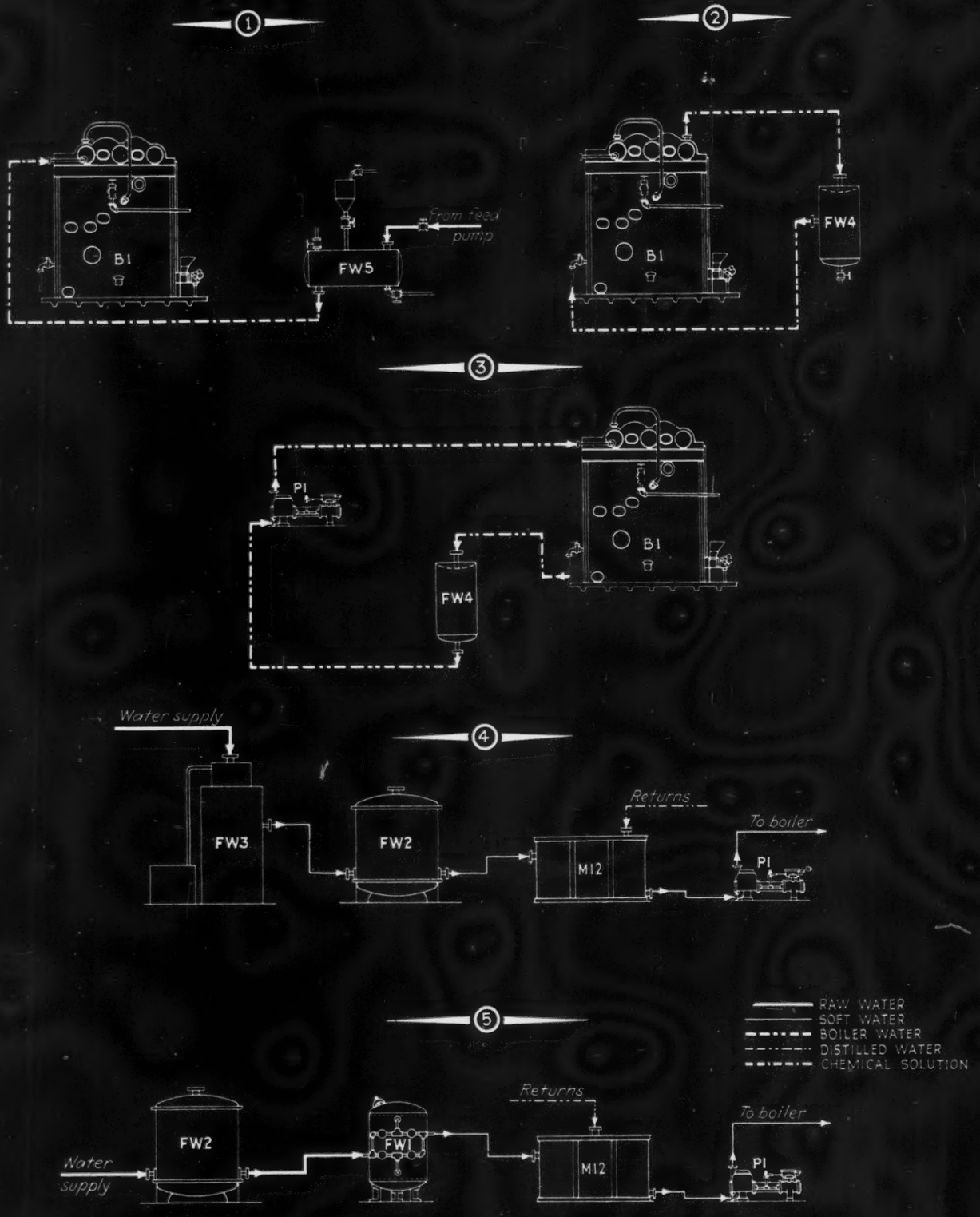
Remarks: Reduces amount of steam bled at higher turbine points for feed heating, thus salvaging power that can be generated from further expansion of that portion of steam.

10

Description: Combination of acid-treated zeolite-softened make-up water with continuous blowdown and heat recovery.

Application: Mainly in large plants where it is desired to maintain a definite sulphate-carbonate ratio.

Remarks: Sulphuric acid is introduced to maintain sulphate-carbonate ratio. Acid addition requires expert control.



B1—Boiler
FW1—Zeolite Softener
FW2—Filter
FW3—Chemical Softener
FW4—Deconcentrator
FW5—Chemical Feed and Tank
M12—Storage Tank
P1—Feed Pump

FEED-WATER TREATMENT

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Hook-Up Number
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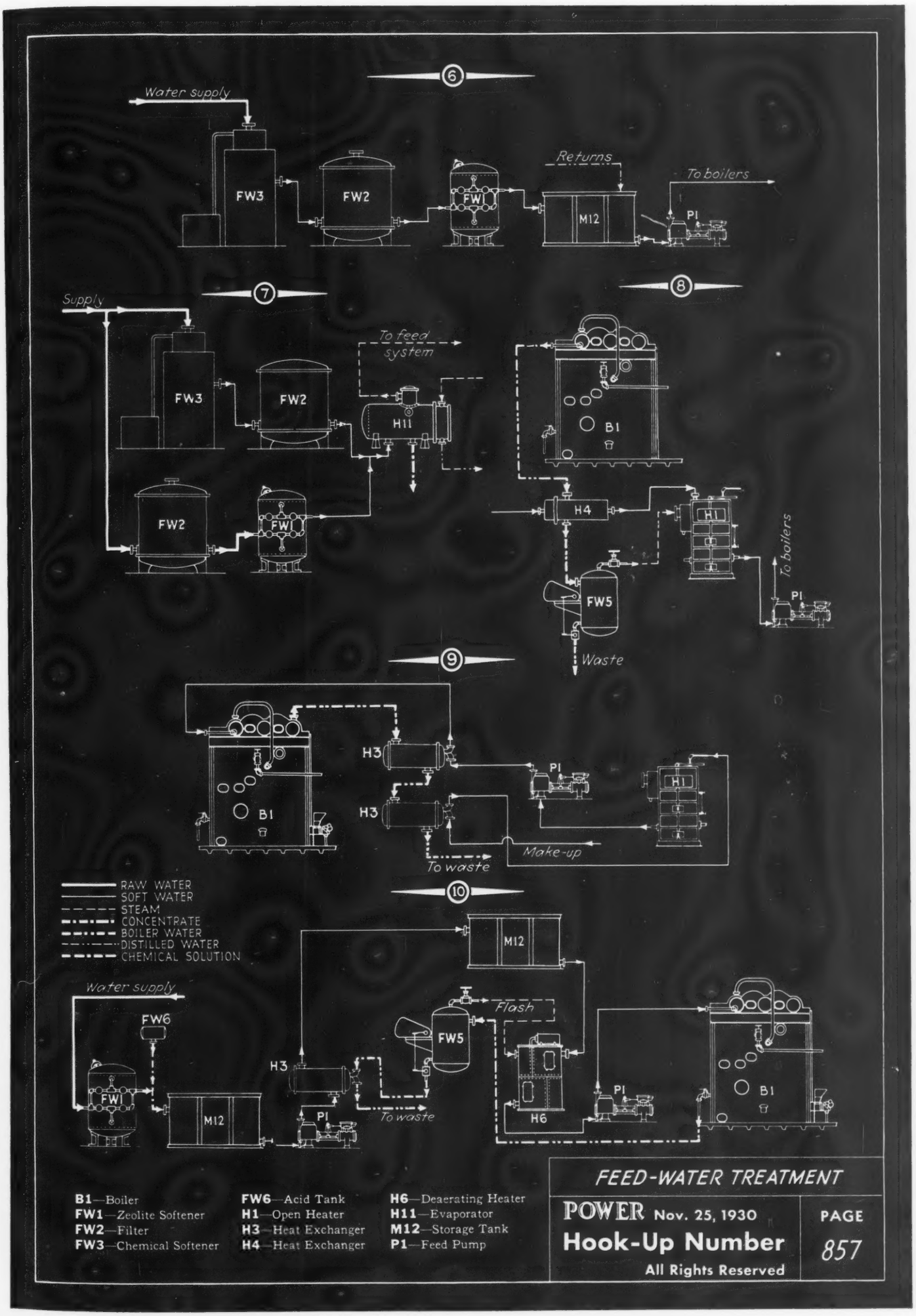

B1—Boiler
FW1—Zeolite Softener
FW2—Filter
FW3—Chemical Softener
FW6—Acid Tank
H1—Open Heater
H3—Heat Exchanger
H4—Heat Exchanger
H6—Deaerating Heater
H11—Evaporator
M12—Storage Tank
P1—Feed Pump

FEED-WATER TREATMENT

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Draft Circuits: Fans, Economizers, Air Heaters

AS ELSEWHERE in this number of *Power,* the aim is to show *sequences* of units—not actual relative positions and sizes. Circuits here shown fulfill the combined functions of draft production and (in most cases) recovery of heat in flue gases. Induced draft alone gives negative pressure in furnace with a tendency toward in-leaking of air. This protects brickwork, but if extreme reduces combustion efficiency. Forced draft alone produces a positive furnace pressure if stack draft is not sufficient to care for draft losses beyond the furnace. Positive furnace pressure avoids dilution of furnace gases but subjects brickwork to higher temperatures. Combinations of forced and induced draft permit a very slight negative pressure in furnace — ordinarily the best condition, safeguarding walls and efficiency.

1

Description: Stack draft only; no heat recovery.

Application: In small installations.

Remarks: Simplest arrangement. Lowest cost per unit of rated boiler capacity. High combustion rates impossible without extremely high stack; hence total installation cost (including boiler) per unit of maximum steaming capacity may far exceed that of a plant with draft fans.

2

Description: Forced-draft fan only; no heat recovery.

Application: In installations where use factor or low fuel cost does not justify heat recovery.

Remarks: Low-cost installation per unit of maximum steam capacity.

3

Description: Venturi-type stack with built-in induced-draft fan.

Application: Used in plants of all sizes.

Remarks: Permits use of much smaller and less costly stack; somewhat greater power consumption than with full-height stack. For large plants, requiring very high combustion rates without excessive negative pressure in furnace, a forced-draft fan would be added.

4

Description: Forced-draft fan to furnace to economizer to induced draft fan to stack.

Application: Where heat recovery with ample draft is required.

Remarks: Induced-draft fan is practically always necessary with economizer to permit high ratings without excessive furnace pressure. An ideal arrangement where feed water cannot be heated to high temperature with bled or exhaust steam and where use factor and fuel price justifies the investment cost of resulting fuel economy.

5

Description: Forced-draft fan to air heater to furnace to air heater to stack.

Application: Where bled steam and exhaust heating of feed water leaves too little temperature margin for economical heat recovery by economizer. Also (particularly with pulverized coal) where resulting increased rapidity of combustion and higher furnace temperatures are desirable.

Remarks: For high ratings induced-draft fan should be added.

6

Description: Same as 5, but with economizer inserted before air heater.

Application: Where use factor and fuel cost justify the maximum heat recovery.

Remarks: Particularly adapted to plants operating at very high pressures to reduce heating surface and cost of boiler proper.

7

Description: Regenerative air heater (integral forced- and induced-draft fans) to process, or to furnace to air heater to stack.

Application: Without process connection, may be used in any type of plant where resulting heat recovery is worth while. With process connection, used in industrial plants requiring large quantities of hot air for heating, drying or similar process.

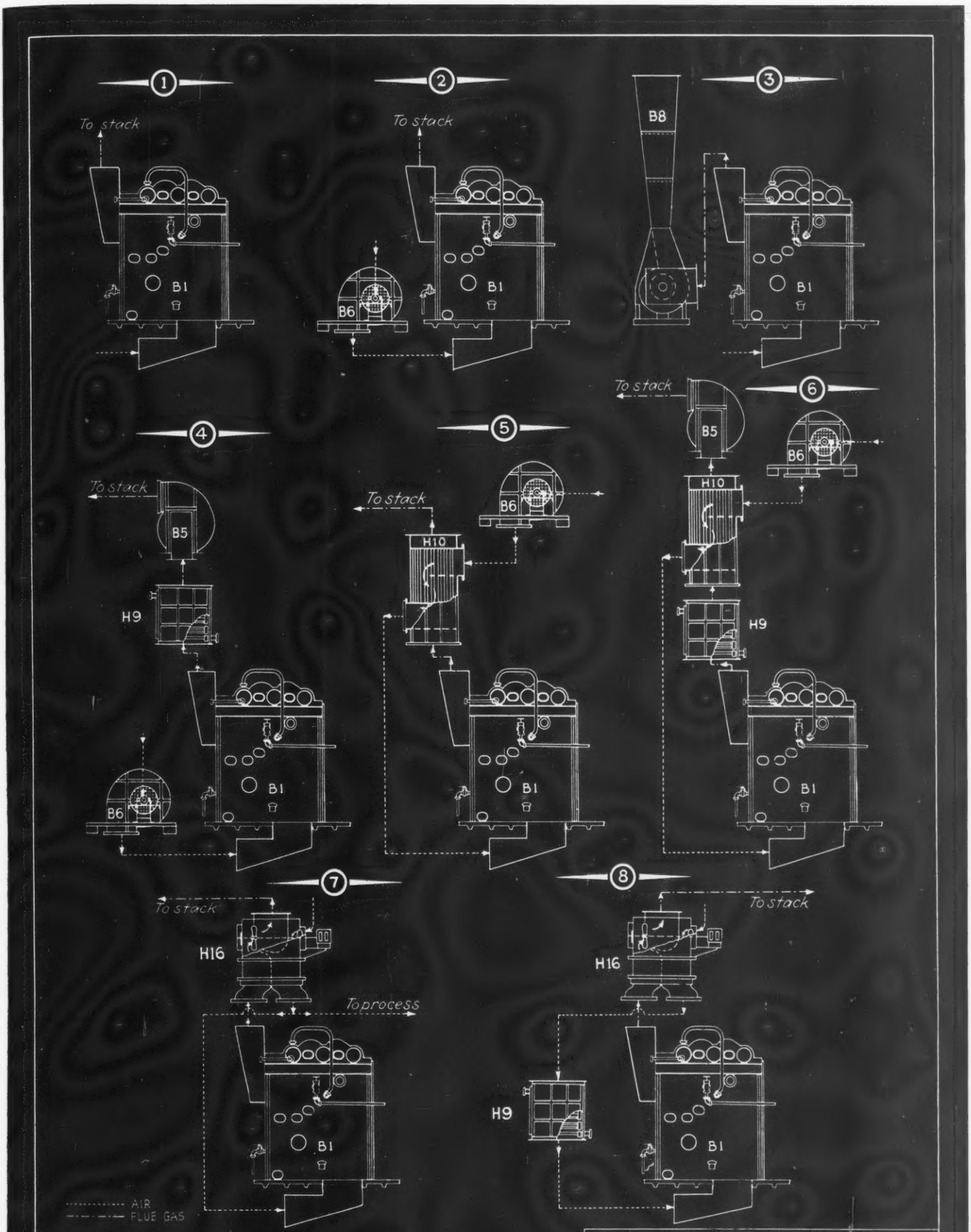
Remarks: More compact than 5. In some cases resulting air temperature may be too high for method of fuel burning, making arrangement for 8 more desirable.

8

Description: Regenerative air heater (with integral fans) to air economizer to boiler to air heater to stack.

Application: Where air temperature to furnace must be kept down.

Remarks: Since air only passes the economizer its cleaning problem is eliminated. In a modification of this system the heated air from the air heater is divided into two portions. One portion goes directly to those parts of the combustion system that can use fully heated air. The remainder is cooled as desired in the air economizer. The regenerative air heater may also be used in series with a gas economizer in the usual manner (equivalent to 6).



B1—Boiler
B5—Induced-Draft Fan
B6—Forced-Draft Fan
B8—Venturi-Type Stack and Fan
H9—Economizer
H10—Air Heater
H16—Regen. Air Heater With Fans

DRAFT CIRCUITS

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Condensing-Water Circuits

SIX CONDENSER circulating-water arrangements are shown. Although a low-head jet condenser is indicated, high-head or multi-jet condensers could be substituted without materially affecting the hook-up. Similarly, a two-pass condenser could be substituted for the single-pass condenser shown. The ejection pump of the jet condenser must handle the cooling water as well as the condensate. The ejection or hotwell pump of the surface condenser handles only the condensate. In America spray ponds and cooling towers have been applied only to relatively small plants, but large installations are found abroad.

1

Description: Jet condenser supplied with injection water of character that can be used as boiler feed.

Application: Where first cost and space are influencing factors and injection water of good quality is available.

Remarks: Low first cost, small space requirements. Boiler feed is contaminated by injection water. Hook-up should not be used with salt or other water unfit for boiler feed unless cheap secondary source of boiler feed supply is available.

2

Description: Surface condenser supplied with cooling water from any source of sufficient volume.

Application: When pure condensate for boiler feed is required.

Remarks: Tubes subject to fouling and corrosion when poor or dirty circulating water is used. Pure condensate returned to boiler feed system. High vacuum obtainable.

3

Description: Jet condenser supplied with injection water from spray pond.

Application: Where no natural supply of injection water is available in sufficient quantities.

Remarks: Spray pond occupies considerable area, which is of importance where land value is high. If make-up to pond contains solids, the pond water will become highly concentrated and so contaminate the feed water. In such cases the pond should be blown down at frequent intervals.

4

Description: Surface condenser supplied with cooling water from spray pond.

Application: Where natural supply of cooling water is insufficient and land values are low.

Remarks: High concentration of pond water is not so important since the condensate and pond water do not mix in the condenser.

5

Description: Jet condenser supplied with injection water from cooling tower.

Application: Where natural supply of injection water is insufficient and ground area is not available for spray pond.

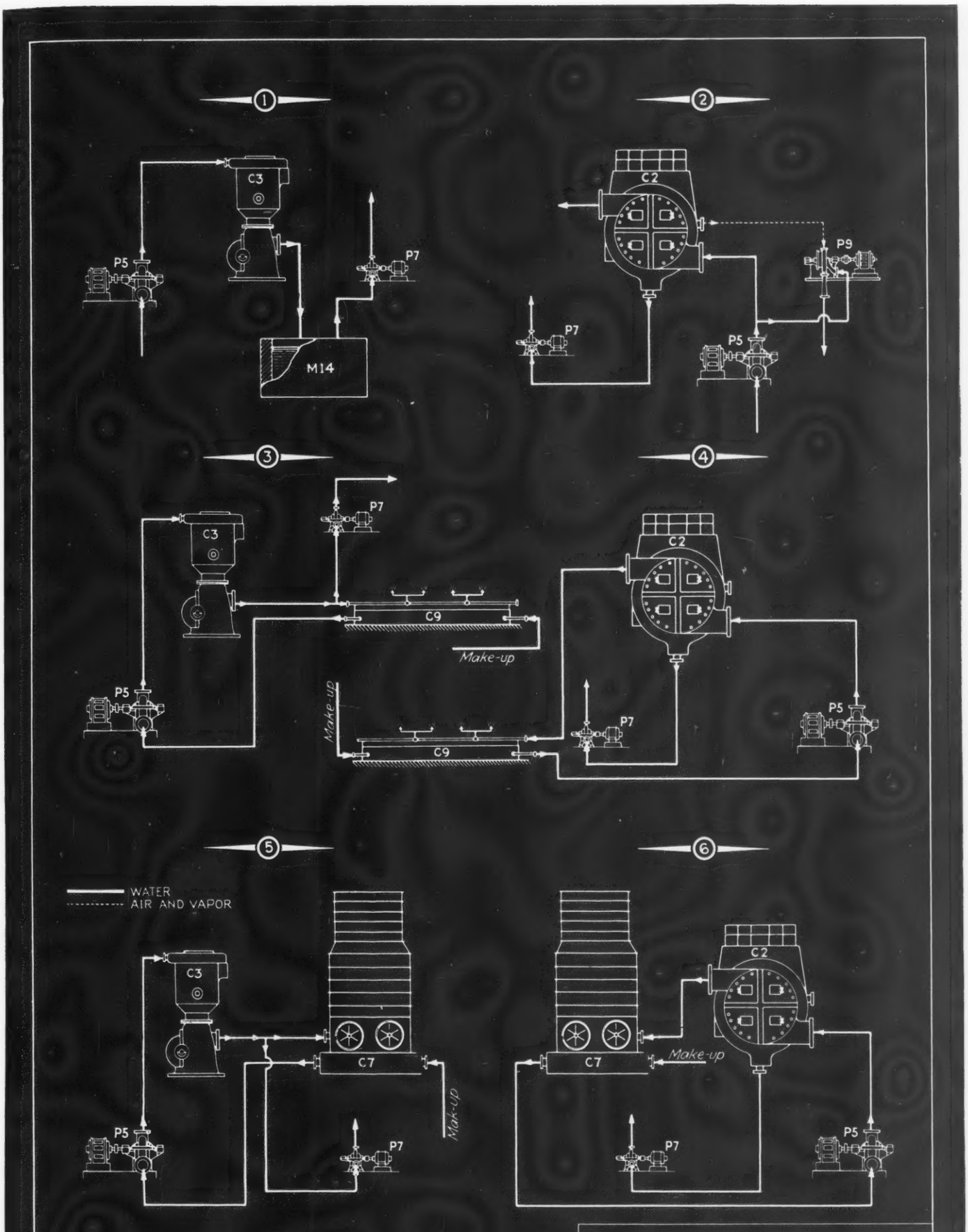
Remarks: Cooling tower occupies small ground area. Wind will not create nuisance by blowing water around neighborhood. Remarks concerning concentration under hook-up 3 also apply to cooling tower.

6

Description: Surface condenser supplied with cooling water from cooling tower.

Application: Where natural supply of cooling water is insufficient and ground area is not available for spray pond.

Remarks: Concentration of cooling water not so important as with jet condenser, since condensate and cooling water do not mix.



C2—Surface Condenser
C3—Jet Condenser
C7—Cooling Tower
C9—Spray Pond
M14—Discharge Canal
P5—Circulating Pump
P7—Condensate Pump
P9—Hurling-Water Air Pump

CONDENSING-WATER CIRCUITS

POWER Nov. 25, 1930
Hook-Up Number

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Superheating and Desuperheating

THE first six hook-ups show sequences of superheater elements within the boiler unit. For simplicity but one type of boiler is shown in the first five hook-ups, but the comments apply to any type of water-tube boiler with equivalent locations of superheater. The remaining hook-ups include equipment beyond the boiler unit to insure supplies of superheated and saturated steam. Resuperheating by saturated steam or furnace gases, as practiced in modern high-pressure steam power plants, is shown on pages 828 and 829.

1

Description: Convection superheater placed after first pass.

Applications: Used where boiler load is fairly constant, or where superheat variations are not objectionable, or where boiler construction does not permit other arrangements. The most common arrangement for moderate superheat.

Remarks: Easy to install. Protected position. Requires relatively large surface for given superheat. Superheat rises with boiler load.

2

Description: Unshielded radiant superheater.

Applications: Used occasionally where some wall protection is desired without use of water walls, and where boiler operates continuously at fairly constant load.

Remarks: Superheat temperature falls as boiler load rises. Takes less tube area than any other type. Requires protection when starting up boiler and shutting down.

3

Description: Radiant superheater (shielded by water wall).

Applications: Same as 2.

Remarks: Falling temperature characteristic, but less sharp than for unshielded radiant superheater. Better protection than 2, but more tube surface. Smaller tube surface than 1.

4

Description: Convection and radiant superheaters in series.

Applications: Used where practically constant steam temperature is required with varying loads.

Remarks: May be used with or without water-wall screening of radiant superheater. With proper proportioning of surfaces rising temperature characteristic of convection superheater practically cancels falling characteristic of radiant, giving fairly constant steam temperature with varying load. Radiant unit can be installed as a booster for an existing convection installation.

5

Description: Interdeck convection superheater.

Applications: Used where high and fairly constant steam temperature with varying loads is desired in a single superheater unit installed with some protection by boiler tubes.

Remarks: Approximates the flat temperature characteristic of 4. Superheater unit costs less than 1 (but boiler alterations may more than offset this). Simpler than 4 and may cost less where boiler changes are not excessive. May be expensive to install where existing boiler and setting must be altered to provide space. Also in new installations where type of boiler does not permit easy alteration.

6

Description: Convection superheater installed at gas inlet of waste-heat boiler.

Applications: Used in waste-heat installations requiring superheat and having a maximum gas temperature below 1,400 deg. F.

Remarks: Minimum tube surface and cost is obtained with this location.

7

Description: Boiler supplying superheated and saturated steam from separate connections.

Applications: Used where the demand for saturated steam does not exceed 20 to 30 per cent of the total.

Remarks: Low first cost, satisfactory operation if little saturated steam is required. Proportion of saturated steam drawn off affects the superheat. If superheated steam demand falls too low superheater may burn out.

8

Description: Saturated steam boiler and separately fired superheater.

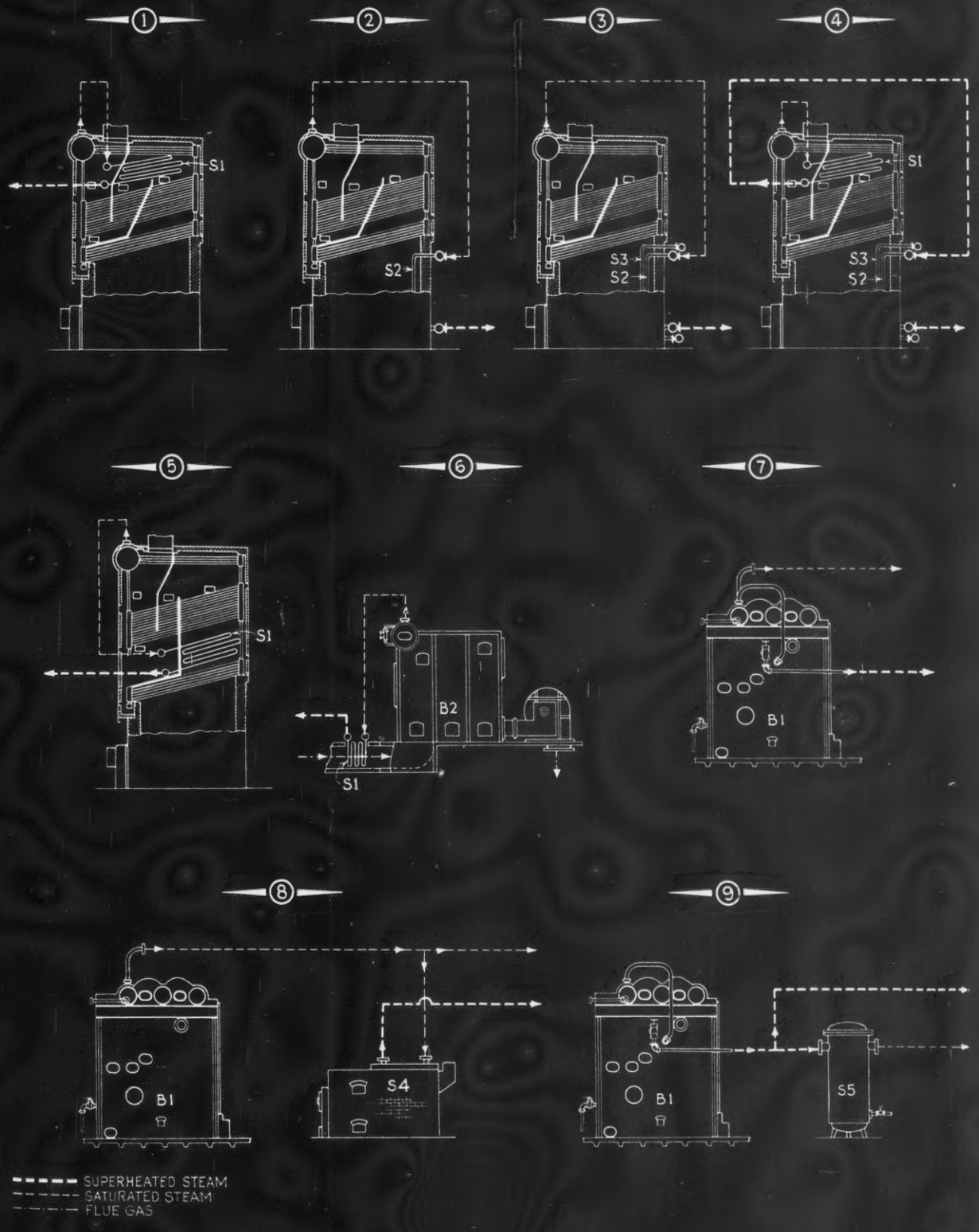
Applications: Used chiefly where the demand for superheated steam is small or occasional.

Remarks: Gives complete control of superheat. First cost and operating cost generally greater than 7. Greater floor area and complication. Low efficiency of fuel used in separately fired superheater unless it includes an economizer.

9

Description: Desuperheater connected to superheated steam outlet of boiler.

Applications: Used in new or revamped plants where saturated steam is required in relatively large quantities. Eliminates danger of superheater burn out when demand for saturated steam is large. Permits close control of temperature of partly desuperheated steam.



B1 Boiler
B2 Waste-Heat Boiler
S1 Convection Superheater
S2 Radiant Superheater
S3 Water Wall
S4 Sep.-Fired Superheater
S5 Desuperheater

SUPERHEATING AND DESUPERHEATING

POWER Nov. 25, 1930
Hook-Up Number

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Refrigeration Hook-Ups

THERE are many possible arrangements of refrigerating apparatus in addition to those shown on the following pages. In all of the diagrams the particular designs of equipment shown may be replaced by other designs. Hook-ups 1 and 2 show simple arrangements widely applied in small and medium-sized plants where the possible savings would not justify greater first cost or complication. The remaining diagrams show more involved combinations suitable for special applications, particularly in large plants where the most effective utilization of energy is economically worth while.

1

Description: Coil evaporator, compressor, double-pipe condenser and cooling tower.

Application: Widely used, particularly for the usual small refrigerating plant.

Remarks: Simple, cheap and fairly efficient.

2

Description: To system 1 an accumulator has been added to precool the liquid. Condenser water is recooled in a spray pond.

Applications: In a plant of any but the smallest capacity the use of the accumulator is necessary if the coils are to be used effectually.

3

Description: This hook-up uses a compound compressor, the intercooler of which is not shown.

Application: For large systems where efficient performance is sought.

Remarks: By intercooling with water between compressor stages the power requirements are reduced. The application of a flash precooler increases the evaporator capacity and reduces the power need. The intercooling may be done by ammonia, in which event the resulting vapor enters the suction of the high-pressure cylinder.

4

Description: To enable the gas forming at the drop from receiver pressure to evaporator pressure to reach the compressor without entering the evaporator, a "flash" receiver is inserted in the system as shown. This flash gas in introduced into the compressor cylinder after the cylinder has been charged with low-pressure gas, giving the Vorhees "multi-effect." A spray pond recools the water which liquifies the ammonia in a multi-pass condenser.

Application: The general plan shown is being adopted in many plants, particularly when carbon dioxide is the refrigerant, as the flash receiver reduces the size of the evaporator and somewhat increases the capacity of the compressor.

5

Description: Here liquid refrigerant passes from receiver into a double-pipe cooler, when it is cooled to approximate water temperature. The refrigerant then enters an accumulator, where it is further cooled by the evaporation of a small amount of the refrigerant. The cooled liquid charge then passes to the two brine coolers. After evaporating, the lower pressure suction gas enters the low-pressure cylinder and, after compression, passes, along with the flash gas and the gas from the high-temperature evaporator, into the high-pressure cylinder of the compressor. Condensation is by a vertical condenser and a spray-pond water.

Application: Where brine at two different temperatures is desired, this system, or a modification of it, may be applied with success.

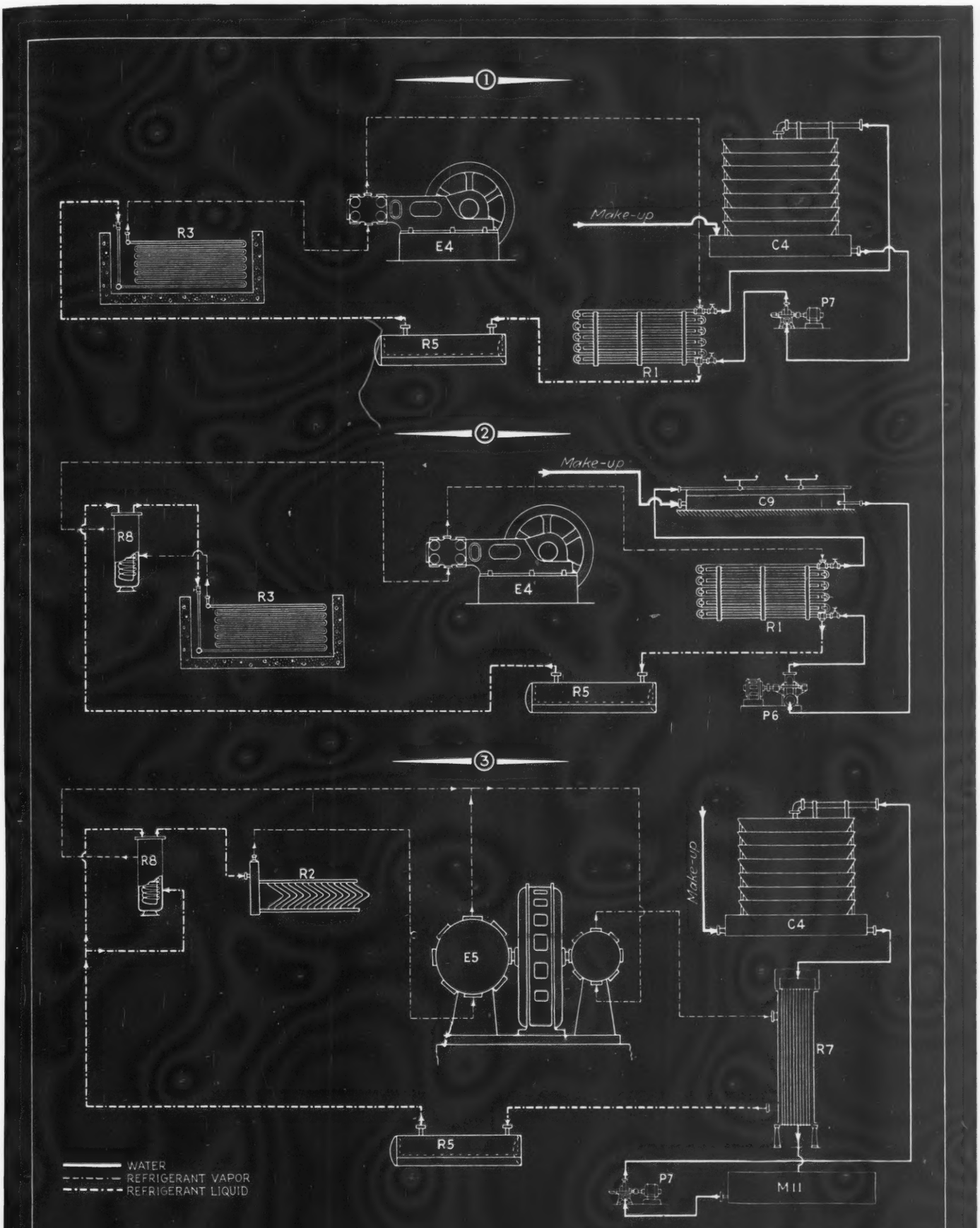
Remarks: In most cases the water-cooled liquid cooler is not justified, as the water temperature is not low enough, but when much cold water is used in processes the water may well be put through the cooler.

6

Description: This layout shows the use of two refrigerants to give a low temperature. Ammonia is expanded in a double-pipe cooler, where it liquifies CO_2 gas coming from the CO_2 compressor.

Application: Where temperatures of, say—50 deg. F. are desired, such an arrangement works out economically.

Remarks: In many instances the CO_2 evaporator would be of the tubular type, and in others the CO_2 system might be the high-temperature system.



C4—Cooling Tower
C9—Spray Pond
E4—Compressor
E5—Two-Stage Comp.
M11—Sump
P6—Pump
P7—Pump
R1—Double-Pipe Condenser
R2—Expansion Coil
R3—Coil Evaporator
R5—Receiver
R7—Vertical Condenser
R8—Accumulator

REFRIGERATION

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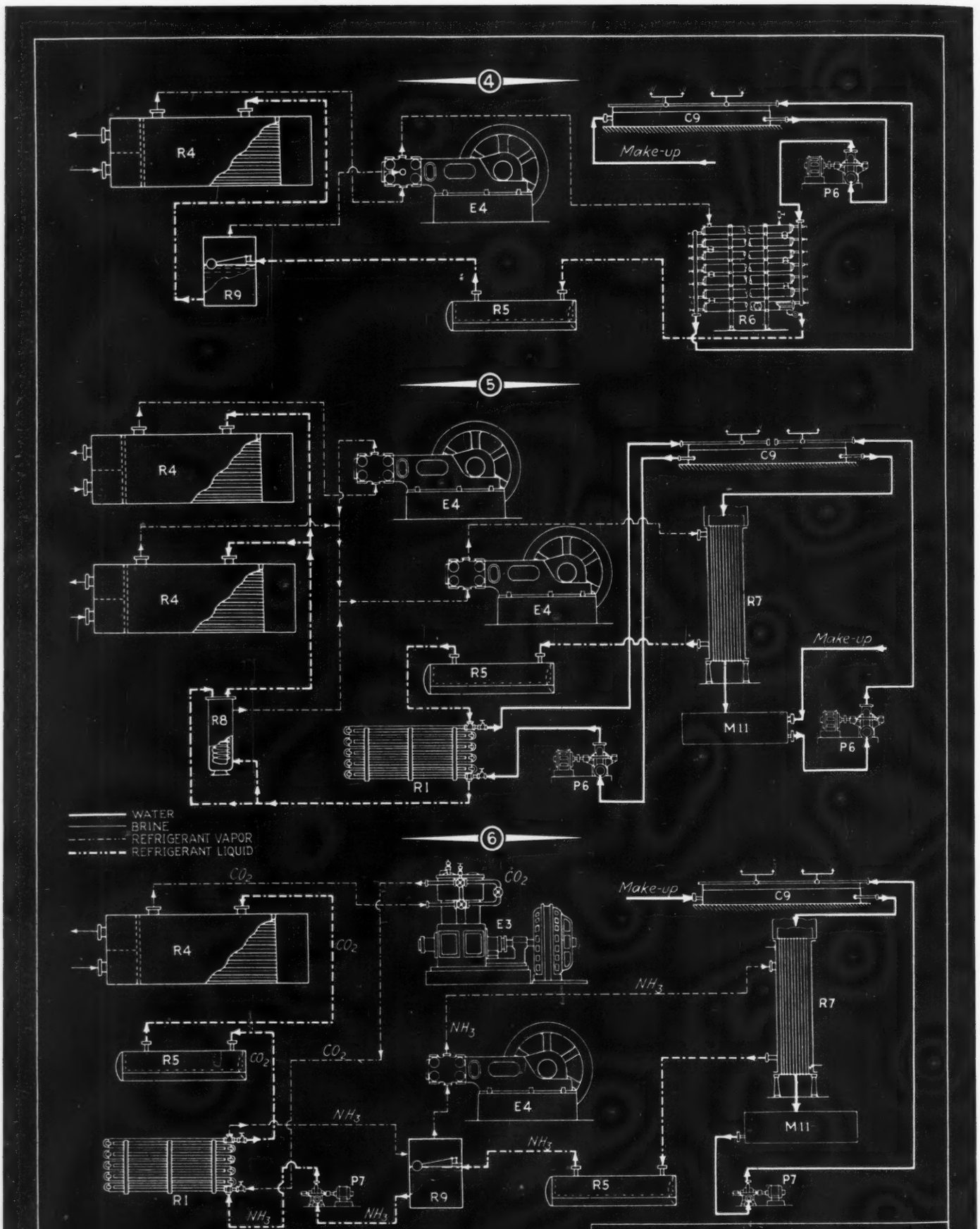

C9—Spray Pond
E3—CO_2 Compressor
E4—Compressor
M11—Sump
P6—Pump
P7—Pump
R1—Double-Pipe Cooler
R4—Brine Cooler
R5—Receiver
R6—Multi-Pass Condenser
R7—Vertical Condenser
R8—Accumulator
R9—Flash Receiver

REFRIGERATION

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Heating and Air Conditioning

HOOK-UPS 1 and 2 concern only heating. No attempt has been made to show various types of heating systems, as this would involve layout details that have been consistently avoided. Hook-ups 3 to 8 concern air conditioning. The first three illustrate methods of handling air to be washed. The last three show the water circuits for air washers used for air conditioning. In industrial applications where close humidity control is necessary means for heating the spray water is frequently provided. Automatic control can be applied to regulate the amount of air recirculated, temperature of spray water and final air temperature.

1

Description: Shows various alternate sources of steam supply to the heating system. Two alternate methods of controlling the heating system, central and individual radiator control, are shown and also three methods of distributing heat.

Application: Direct radiation for general heating. Unit heaters for heating large industrial spaces. Blast heating for heating auditoriums, theaters, schools and lobbies.

Remarks: Discussion concerning the alternate methods of supplying steam is given under "Steam Power and Process." Whenever possible, exhaust or bled steam should be used for heating. Centralized control is relatively inexpensive and reduces steam consumption. Individual radiator control gives close regulation of room temperature.

2

Description: Alternate methods of obtaining hot water for a forced-circulation hot-water heating system. B11 here represents a hot-water boiler.

Application: Hot water can be used wherever direct radiation is installed in moderate-height buildings.

Remarks: Hot-water heating is ideal for central control. Requires long heating-up period. Large amount of radiating surface necessary. Less intense heat given off by radiator.

3

Description: All air to be conditioned is taken from outside, passes through tempering coils, air washer and heating stack.

Application: For conditioning spaces where objectionable contamination cannot be removed by air washing.

Remarks: Requires excessive refrigeration and heating.

4

Description: Exhaust fan returns vitiated air to air-washer inlet where it is mixed with some fresh air before reconditioning in air washer.

Application: Where contamination of return air can be removed by washing.

Remarks: Refrigerating and heating requirements greatly reduced.

5

Description: About half of return air is recirculated without washing. Remaining portion and fresh air pass through air washer.

Application: When return air is not contaminated.

Remarks: Lower humidity can be obtained with less refrigeration and without reheating with steam.

6

Description: Water used for washing is recirculated without cooling.

Application: Where expense of refrigerating equipment is not justified.

Remarks: Air entering washer is cooled to within a few degrees of wet-bulb temperature and leaves with about 100 per cent humidity. Water added to make up for evaporation.

7

Description: Water for air washing is cooled in a closed cooler and delivered to the spray pump.

Application: Where complete air conditioning is required.

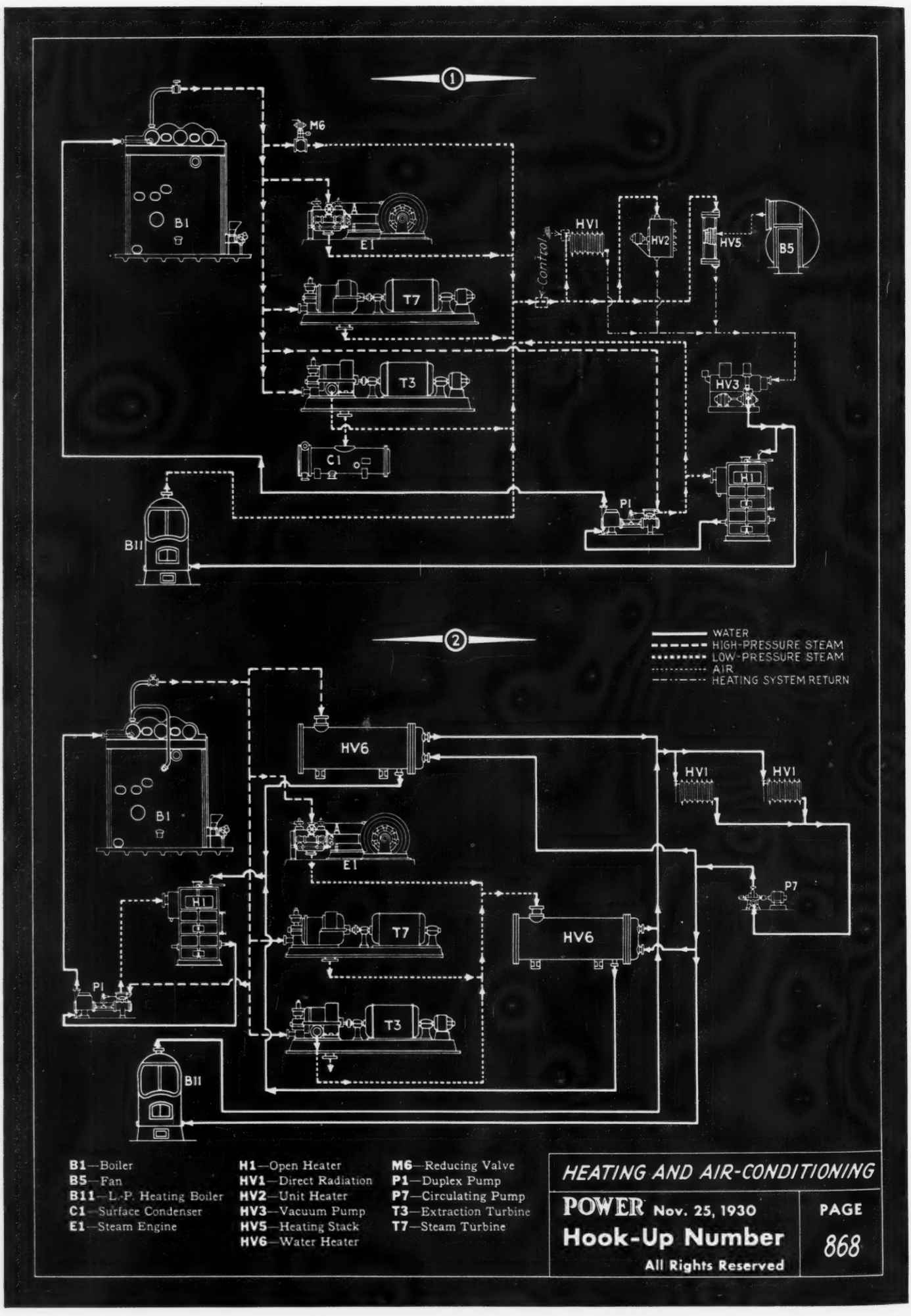
Remarks: Temperature of spray water regulated by controlling brine. Requires excessive pumping energy. Greater cooling and lower humidity can be obtained than with 6.

8

Description: Water for air washer is cooled in a spray cooler and pumped to a closed receiver tank. Three-way valve under thermostatic control admits cold water to spray pump in quantities sufficient to maintain spray water at desired temperature.

Application: Where complete air conditioning is required.

Remarks: Closed tank is provided to maintain a constant head on control valve. Closer control of temperature is obtainable.



B1—Boiler
B5—Fan
B11—L.-P. Heating Boiler
C1—Surface Condenser
E1—Steam Engine
H1—Open Heater
HV1—Direct Radiation
HV2—Unit Heater
HV3—Vacuum Pump
HV5—Heating Stack
HV6—Water Heater
M6—Reducing Valve
P1—Duplex Pump
P7—Circulating Pump
T3—Extraction Turbine
T7—Steam Turbine

HEATING AND AIR-CONDITIONING

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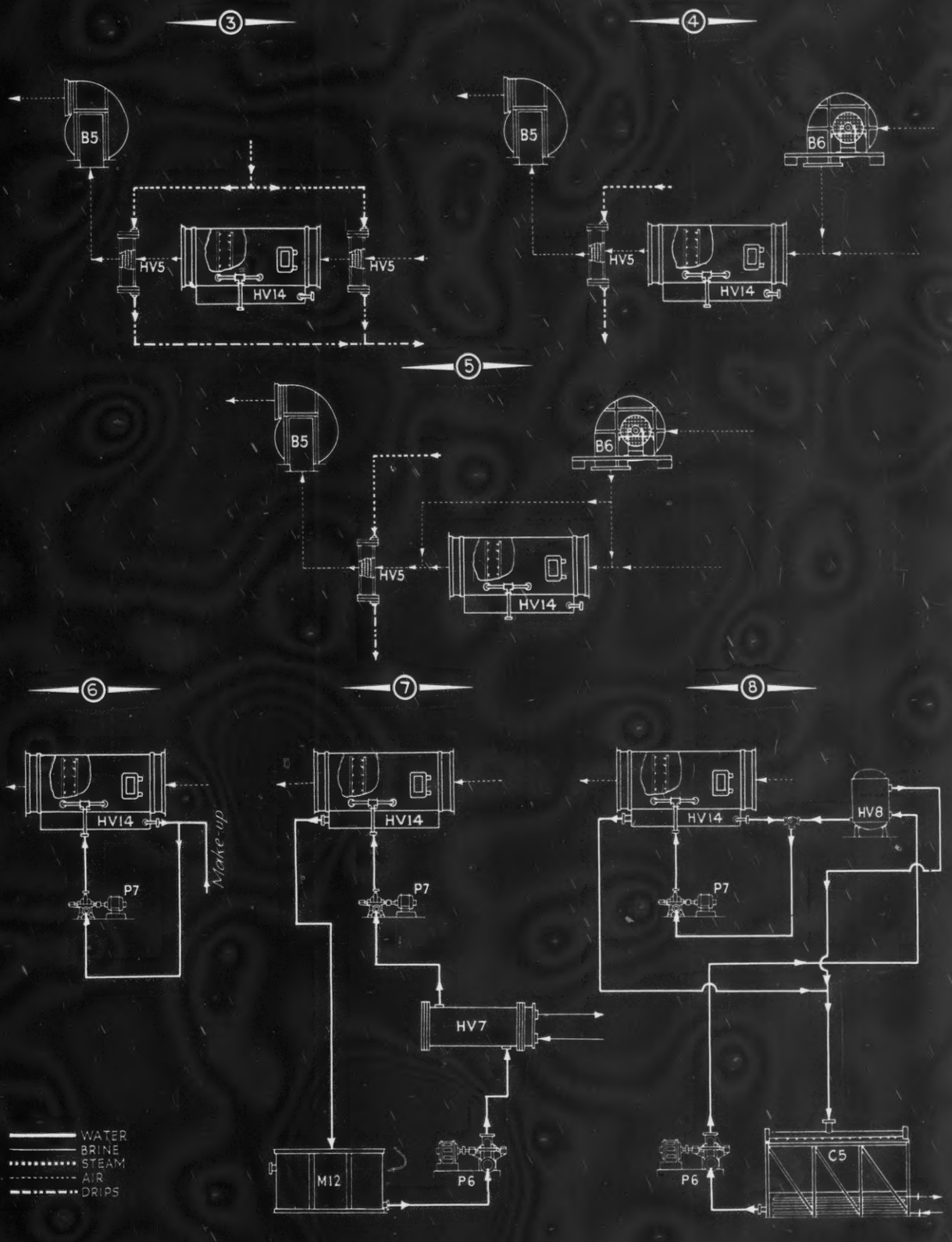

B5—Supply Fan
B6—Return Fan
C5—Spray Cooler
HV5—Heating Stack
HV7—Water Cooler
HV8—Closed Tank
HV14—Air Washer
M12—Tank
P6—Circulating Pump
P7—Spray Pump

HEATING AND AIR-CONDITIONING

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A Concluding Word On the Use of Hook-Ups

FUNDAMENTALLY, thinking is a process of comparing. Such a simple matter as deciding whether to drive or walk involves first a mental picture of each process and its probable results. In an instant one checks off the various pros and cons and decides that the exercise of walking is worth the resulting delay, or that getting there in a hurry is more important. For this one needs no blue print, because the problem is simple and the final decision relatively unimportant.

Difficult in application, but the same in principle, is the thinking that leads to power decisions. Here the possibilities from which choice must be made are many and complex, so that snap judgment is no longer equal to the task. Before even preliminary plans are made for new plants or extensions, all hook-ups of possible value in the given connection should be compared. Omission of this essential step has been responsible for many plants that are excellent examples of their types but of decidedly wrong types for the existing conditions.

There is an old saying about "not seeing the forest for the trees." This danger constantly confronts the power engineer, whether his problem be design or operation or both. To avoid it he must, at intervals, consciously step out and up to survey the whole scene. In this process the editors feel that the reader can get much practical help from the one hundred and ten power hook-up diagrams in the preceding pages.

Naturally, space limitations have made it impossible to show every basic hook-up; additional combinations will undoubtedly come to the reader's attention. On the other hand, elimination of incidental details has made it possible to include a substantial proportion of those that are worth while.

It is believed that engineers everywhere will find these pages of practical value in solving their power problems—present and future.

NEWS of the FIELD

National Power Show in New York, Dec. 1-6 Expected to Draw Record Attendance

Heavier and larger units, equipment in actual operation and many new models will be featured at this year's exhibit

RUNNING from Dec. 1 to 6 at the Grand Central Palace in New York City, the National Power Show will present this year one of the most extensive arrays of power equipment ever shown in the nine years of its history. Virtually every branch of machinery and apparatus in the power generation and mechanical engineering fields will be represented at the show in the displays of more than 400 exhibitors. With no National Power Show scheduled for next year, attendance at this year's exhibit is expected to break all records.

A notable feature of the show will be the heavier and larger units, many of them in actual operation. One nationally known manufacturer, for instance, has arranged to show one of the largest units that go into the operation of a power plant, in so far as fuel-burning equipment is concerned, under practical operating conditions.

The keen rivalry of the past few years between the manufacturers of pulverized-fuel equipment and those who manufacture automatic stokers will be reflected in the show in that both classes of equipment will be represented in a greater and more interesting variety than ever before. The two schools of practice will certainly have an excellent opportunity to compare the mechanical equipment that is now offered, and those who felt some years back that the automatic stoker had reached the zenith of its development will be interested to note the refinements that the demands of modern power production have brought about in the new types of automatic stokers.

The demands of the modern trend toward high pressures in boilers will be reflected in the unusually fine and diversified group of instrument makers who will show new devices. One instrument concern has requested additional space this year, having been marking time for the past few months. There will also be a number of new instruments at the show, several manufacturers having stated that they will show new designs to meet modern demands.

That air is an important factor in the production of power will be emphasized by the exhibits of the fan makers, who will, as seems to be the keynote of the show, exhibit larger and more complete units than heretofore, and even the air conditioning of the plant will receive its share of attention with practical exhibits covering this point. Several years ago but few would have considered the desirability of spending money for such a project, but today air conditioning is one of the factors that receives consideration, especially in pulverized-fuel and oil installations.

Tremendous combustion rates develop tremendous heat, yet to walk into the modern boiler room one does not realize it. The old type hand-fired boiler plant with men stripped to the waist and sweating their lives away in the withering heat is a thing of the past. Insulation of the side wall, and water and air cooling have solved that problem. There will be water walls and air-cooled furnace blocks with all the latest wrinkles in the art of their construction. The field of insulation will have exhibits that will visualize this material in service in every industry, including a range for every industrial temperature and every industrial condition; a flashing, lighted chart will flash a temperature range thermometer for various types of insulation, beside which will be actual samples of the insulation itself. The range will be from sub-zero conditions to the highest industrial temperatures.

Boilers of the most modern type, of which in the past few years there has been a rapid development, will be visualized in unique ways by their manufacturers. Air preheating having become a standard practice in practically all plants of a certain type, there will be several of these of different types to be seen. The various newer combinations of air preheater, water wall and boiler will be explained by their respective sponsors.

With the demand for ever larger plants a new demand for knowledge has come about. That is a knowledge of pipe and piping. Little was thought about it until it became an ever increasing factor in the design and construction as well as operation of the modern plant. To visualize this, one booth will show how piping and tubes are made. This exhibit is entirely new this year and will attract much attention. Along the same line is the exhibition of a special alloy steel that has heretofore not been shown at the power show, and indicates the refinements that are entering into the boiler room.

Exhibits of refractories will be particularly complete this year. One manufacturer announces that it will show a recently completed 5,000-ft. motion picture which illustrates modern methods employed in the manufacture of refractories. The film depicts every step in the production of refractories from the mining of raw materials to the loading and shipping of the finished product.

In material handling we again find the influence of the larger higher duty plant reflected in the equipment to be shown. It is significant that more concerns in this line of business have signed for space to date than any year heretofore.

Ask N. Y. Utilities to Report Special Rates

IN ORDER to ascertain how prevalent is the practice of making special rate contracts with favored customers by public utility corporations, the New York Public Service Commission has issued an order to every electric company operating within the state to file with the commission not later than Dec. 1, a list of all such special contracts with any individual, class or group of consumers.

That several such "secret" agreements are in existence today was the belief of the commission. Chairman Milo B. Maltbie declared that steps would be taken to meet the situation as soon as the reports were received and the prevalence of the practice determined.

"Whatever may be the justification in private business for special rates, terms or conditions," he said, "there is no reason in the public utility business, either in law or in equity, why there should exist special contracts of which one consumer has knowledge and of which other consumers are denied knowledge. The principle that all rates shall be open to the public is now fundamental and for twenty years has been recognized as a sound principle in this state."

To Discuss Power Subjects at Ten Sessions Of A.S.M.E. Annual Meeting, Dec. 1-5

Presentation of John Fritz medal, honorary membership to Elihu Thomson and Professor Smith's address are features of program

WITH PAPERS COVERING power subjects to be presented at ten of its thirty-one technical sessions, the annual meeting of the American Society of Mechanical Engineers, which will be held in New York City on Dec. 1 to 5, promises much of interest to power engineers. Lubrication, hydraulics, industrial power, railroad power, fuels, welding, steam tables, central stations, oil and gas power, refractories and refrigeration are among the topics to be discussed.

Of equal interest will be the program of general events and entertainment features. At the annual dinner to new members to be held at the Hotel Astor on Dec. 3, Admiral David Watson Taylor, renowned naval constructor, will be awarded the John Fritz Medal, the highest honor bestowed by the engineering profession. Ely C. Hutchinson, editor of *Power*, will act as toastmaster at the dinner, and Elliott Dunlap Smith, director of industrial investigations at the Institute of Human Relations and professor of industrial engineering at Yale University, will deliver an address on "Engineering Encounters Human Nature," in which he will show how enormously potent the engineer really is in the social problems of today.

President's night, Dec. 2, will be the occasion for a discussion between an economist and an engineer concerning the parts these two professions play in our present civilization. Dr. Wesley C. Mitchell, director of the National Bureau of Economic Research, and Ralph E. Flanders, vice-president of the A.S.M.E., will be the speakers. At this time honorary membership in the society will be conferred upon Elihu Thomson, a leading American scientist.

The program of papers on power subjects to be presented at the various technical sessions is as follows:

MONDAY AND TUESDAY

"The Work Factor of Lubricating Oil," by James G. O'Neill; "Evaluation of Steam Turbine Oil Stability," by Clifford M. Larson; Progress Report of the Petroleum Division.

"Federal Relations to Water-Power Development," by F. E. Bonner; "A Method for Standardization of Centrifugal Pumps," by J. S. Stepanov; Progress Report of the Hydraulic Division by Byron E. White; "High-Pressure and High-Temperature Steam," by C. F. Hirschfeld; "Engineering Aspects of Interchange of Power With Industrial Plants," by B. F. Wood; "Combined Heat and Power Supply in Industrial Plants," by W. F. Ryan; "The Stug System of Pulverized Fuel Firing on Locomotives," by R. Roosen.

WEDNESDAY

Progress Report of Fuels Division by T. A. Mangelsdorf; "Heat Absorption in Water-Cooled Furnaces," by W. L. DeBaufre; "Radiant Heat Transmission Between Surfaces Separated by Non-Absorbing Media," by H. C. Hottel; "Frictional Resistance and Flexibility of Seamless Tube Fittings in Pipe Welding," by Sabin Crocker and A. McCutchan; steam tables discussion.

THURSDAY

"Operating Experiences at Deep-water Station," by K. M. Irwin; "Operation of Holland Station," by E. M. Gilbert; Progress Report of Oil and Gas Power Division by M. J. Reed; "Some Features of the Long-Distance Transportation of Natural Gas," by G. I. Rhodes and E. G. Hill; "A Simple Method for the Calculation of Natural Frequencies of Torsional Oscillation," by F. P. Porter; "Comparative Resistance of Refractories to Coal-Ash Slags," by R. K. Hursh; "Action of Slags on Firebrick and Boiler Furnace Settings," by T. A. Klinefelter and E. P. Rexford; "Furnace Gas Compositions and Temperatures in Underfeed Stoker-Fired Boilers and Their Effect on Boiler Settings," by A. C. Pasini and E. M. Sarraf.

FRIDAY

"On Problems in the Theory of Fluid-Film Lubrication, With an Experimental Method of Solution," by Albert Kingsbury; Lubrication Research Activities, Fifth Report of the A.S.M.E. Special Research Committee on Lubrication; "Properties of Non-Ferrous Metals at Elevated Temperatures," by C. L. Clark and A. E. White; "Comparative Physical Properties of Chromium-Manganese and Manganese Steels," by C. L. Clark and A. E. White; "Effect of Humidity on the Heat Transmission of Galvanized Pipe," by W. R. Woolrich; "Psychometry and the Effects of Air Conditioning on Some Familiar Products," by Daniel C. Lindsay.

Super-Power System Planned for Europe

A EUROPEAN SUPER-POWER SYSTEM of huge proportions is now under discussion, according to a recent statement of the American Committee of the World Power Conference. Based on economic grounds, the system envisages linking the water powers of Norway, Sweden, France, Switzerland, Spain, Italy, Austria and Jugoslavia with the coal resources of France, Germany, Poland and Ukraine, the lignite resources of Germany and Czechoslovakia and the oil resources of Roumania and Ukraine.

Five trunk lines are contemplated—three running north and south and two, east and west, the latter interconnecting the three others. About 6,000 miles of high tension line will be required, and the transmission voltage is to be between 380,000 and 400,000 volts. The total cost of the system including regulating and transformer stations, but not generating stations, is estimated at $500,000,000.

The idea of the Pan-Europe super-power network is to conserve what would otherwise go to waste and to make possible the production of electricity and the utilization of natural resources in districts where without such a network to absorb and distribute the power, complete electrical development would be uneconomical. In principle, however, only such power will be imported from other countries as can either not be had at home, or only at a higher price.

Announce Program for Fuel and Power Week in Chicago

FROM FEB. 10 to 13, inclusive, two meetings of national engineering importance will be held at the Stevens Hotel, Chicago, Ill. The Fifth Midwestern Power Engineering Conference will have sessions on power economies, electricity, refrigeration, prime movers, metallurgy, water treatment and civil engineering subjects. Foremost authorities will present papers sponsored by eight organizations in these fields. The Fourth National Fuels Meeting also has arranged an attractive program covering the field of fuel burning and utilization. Papers to be presented at these meetings are:

NATIONAL FUELS MEETING

"Use of Refinery Waste Fuels in the Modern Steam Plant," by H. J. Klotz; "Mining, Preparation and Utilization of Anthracite," by C. A. Connell; "Processes of Dehydrating Low-Grade Coal," by Max Toltz; "Developments in the Small Stoker Field," by T. A. Marsh; "Conversion of Small Coal-Fired Furnaces to Gas Firing," by W. D. Edwards; "Dust Recovery and Air Pollution," by H. N. Dubar; "New Developments in Furnace Design," by E. G. Bailey; "Slag Tap Furnaces," by A. L. Baker; "Developments in Pulverized-Fuel Firing," by H. Kreisinger.

"Recent Developments in the Preparation and Utilization of Byproducts from Bituminous Coal," by A. C. Fieldner; "Effect of Fineness of Pulverization on Boiler Efficiencies," by E. H. Tenney; "Heat Absorption in Boilers, Including Radiation," by N. Artsay; "Reduction of Unaccounted Losses in Boiler Tests," by W. F. Davidson; "Selection and Co-ordination of Steam Generating Equipment," by F. H. Rosencrants; "Boiler Plant of the Future," by George A. Orrok; "Changes

in Character of Midwest Coals and Stoker Performance," by E. L. McDonald.

MIDWEST POWER CONFERENCE

"Power and Its Effects on the Methods and Progress of Modern Civilization"; "Balancing Plant Investment With Operating Cost," by A. H. Kehoe; "Advance in Electrical Distribution," by H. W. Eales; "Commercial Distribution of High-Pressure Steam," by J. M. Drabelle; "New Application of Refrigeration in Air Conditioning," by W. H. Carrier; "Power Requirements in the General Cold Storage Industry," by George Horne; "Trends in Steam Turbine Development"; "Reciprocating Engines for the Higher Pressures," by J. F. Ferguson; "The Influence of Internal Combustion Engine Design on Practical Application," by H. F. Shepperd.

"Water Turbines of the Propeller Type," by L. F. Harza; "High-Temperature Metals for the Power Plant," by L. W. Spring; "Power Requirements for the Pumping of Oil, Gas and Gasoline"; "Electric Arc Welding in the Power Plant," by W. H. Zorn; "High Voltage D.C. Transmission," by C. W. Stone; "Late Developments in Pretreatment of Boiler Feed Water," by S. T. Powell; "Developments in Evaporator Practice and Design," by F. S. Collings; "Concentration Control of Boiler Water," by H. S. Whiton; "Geology and Reservoir Power Plants," by M. M. Leighton.

Floating Power Plant Goes Into Service

ELECTRIC ENERGY from the power ship Jacona, equipped by the New England Public Service Company as a movable auxiliary plant to give standby service, was put to its first commercial use Nov. 18, when approximately one-third of its total capacity of 20,000 kw. was tied in with the new plant of the Maine Seaboard Paper Company at Bucksport, Me.

The initial output was used for testing purposes, preparatory to beginning operations at the paper company's plant as soon as the plant is completed. When operations are in full swing this plant will consume nearly 100,000,000 kw.-hr. of electric energy yearly to be supplied from the new Wyman Dam at Bingham. Prior to completion of that project, power will be supplied from the power ship Jacona.

More Liquified Gas Plants

Permission has been granted by the California Railroad Commission to the Inland Empire Gas Company to construct liquefied natural gas plants in the communities of Imperial, Brawley, Heber, and Calexico, in lieu of artificial gas plant heretofore authorized by the commission.

International Acetylene Association Holds Record Meeting at Chicago, Nov. 12-14

Papers and report show growth in use of gas welding in piping, refrigeration, heating and power-plant fields.

IT WAS GENERALLY CONCEDED that the thirty-first annual convention of the International Acetylene Association, held from Nov. 12 to 14 at the Congress Hotel, Chicago, was the best meeting in the history of the organization. The attendance was better than ever before, as indicated by a registration of 460 compared to 351 for the year before and 240 in 1928. The papers presented were excellent and diversified in character to cover the expanding field of the gas welder. Sessions were devoted to welding in the metal-working industries, building structures and piping, transportation and public utility fields.

Several papers were devoted to oxy-acetylene gas welding for pipe lines, city gas mains and industrial and house piping. In one of these R. E. Fritsch of Louisville stated that all piping is to be welded in the extensive buildings for the New York Hospital and Cornell Medical College, which job involves about 10,000 welds and the cutting of about 3,000 branch outlets. In his opinion, the steam piping field offers great possibilities for the application of welding. The annual report of the distribution committee before the convention of the National District Heating Association showed that out of seventeen companies distributing steam in the largest cities in the country, only one was not using welded joints in mains and service lines. The use of the oxy-acetylene welding and cutting torch in the fabrication and erection of steam heating systems has spread rapidly in the past year. The use of the oxy-acetylene welded pipe joint in the refrigeration field likewise is becoming more general.

In high-pressure power piping installations engineers have been reluctant to use welded joints. Notwithstanding this attitude, reference was made to a power plant being designed by a leading New York engineer for a 400-lb. boiler plant in which all of the piping will be oxy-acetylene welded. The 200-lb. oxy-acetylene welded installation at the Bureau of Standards has been in service about eighteen months and the installation has proved entirely satisfactory. Use of the cutting and welding torch in making changes in power plant piping, the author considered of outstanding value. Welding also simplifies layout problems and the insulation of high-pressure steam piping, the paper said.

In the actual application of oxy-acetylene welding in the steam boiler field, the progress report of the past year showed little advance, but the willingness of the A.S.M.E. boiler code committee to receive model specifications for fusion welding of steam boiler drums indicated a distinct advance.

Oxy-acetylene welding continued to make distinct progress in the power plant field. For joints in steam piping operating at boiler pressures, welding has been accepted more generally in the industrial power plant than in the central station. Practically all utilities made extensive use of gas welding and gas cutting, but in many cases high-pressure steam lines are still made up with flanged joints. Inspection of such plants however, revealed an enormous amount of welding on steel casings of boiler settings, bunkers, pulverized-coal ducts, fans, heaters, etc., on stairways, exhaust piping, tanks and in many other places. Development of welded power equipment by manufacturers continued apace. For example several are working on designs of steam turbines with welded casings and welded machine bases are common

An event of the meeting was the award of the Morehead Medal to J. B. Johnson, chief of the material branch of the Army Air Service at Dayton, Ohio. W. A. Slack, past president of the association, presented the medal, which is awarded annually for original research and development in the application of welding to aircraft construction.

Officers elected for the coming year were as follows: president, W. D. Flannery, K-G Welding & Cutting Company, Chicago; vice-president, W. C. Keeley, Jr., National Carbide Company, New York; secretary-treasurer, A. Cressy Morrison, New York. Directors, W. A. Slack, H. S. Smith, L. F. Loutrel, W. H. Ludington, C. A. McCune, J. A. Johnson, G. B. Walker, R. A. Sossong.

Ozark Dam Plant to Be Modernized

Empire District Electric Company of Joplin, Mo., has launched a $1,750,000 construction project which will greatly improve the power generation and transmission system in the eastern division of the territory served.

The project involves the installation of new equipment in the company's Ozark Dam Plant at Ozark Beach, Mo., on White River, which will increase the generating capacity of 27,000 hp., and the construction of a new transmission line between the dam and Aurora.

The original horizontal type water turbines will be replaced with five modern generating units of the vertical type, and the frequency will be changed from 25 to 60 cycles. The old equipment has been in service since the plant was built in 1913. Indications are that the alterations will be completed by January.

J. A. Bergin, Power Engineer, Killed in Mine Accident

JOE A. BERGIN, general superintendent of the Philo Plant of the Ohio Power Company, was killed Nov. 5 in a mine gas explosion, while present as one of a party of Sunday Creek and Columbia Cement officials inspecting new workings and methods of mining and preparation of coal at the Millfield, Ohio, mine. The explosion resulted fatally to the entire party as well as 70 miners

Joe A. Bergin

during this, Ohio's greatest, mine disaster. Mr. Bergin was 44 years old.

Born in the vicinity of Detroit, Mich., Mr. Bergin received his early education there. For fifteen years he was engaged in various power plant operating activities for the Detroit Edison Company, except during the World War when he was in charge of steam making equipment for the du Pont company's munitions operations near Nashville, Tenn. In 1921 he resigned as field supervisor of power station construction with the Detroit Edison and joined the American Gas & Electric system, first as results engineer at the Windsor Plant of the Beach Bottom Power Company, and later as assistant to the manager.

During the construction of the Philo Plant of the Ohio Power Company, Mr. Bergin served as assistant superintendent of construction, and upon operation of the plant he assumed the duties of general superintendent. His efforts contributed greatly to the success of this plant, the first high-pressure station with reheated steam to be installed in this country. He was regarded by his associates as one of the best power plant engineers.

Mr. Bergin was actively engaged in the work of the Prime Movers Committee of the National Electric Light Association, holding the chairmanship of the boilers, superheaters and economizers sections as well as the vice-chairmanship of its other branches. He was a member of the American Society of Mechanical Engineers and various clubs and fraternal organizations adjacent to his home in Philo, Ohio.

COMING CONVENTIONS

American Society of Mechanical Engineers. Annual meeting in New York City, Dec. 1-5. National Fuels Meeting in Chicago, Ill., Feb. 10-13, 1931. Secretary, Calvin Rice, 33 West 39th St., New York City.

American Institute of Electrical Engineers. Annual Winter convention in New York City, Jan. 26-30, 1931. Secretary, F. L. Hutchinson, 33 West 39th St., New York City.

American Society of Heating and Ventilating Engineers. Annual meeting at the William Penn Hotel, Pittsburgh, Pa., Jan. 26-29, 1931. Secretary, A. V. Hutchinson, 51 Madison Ave., New York City.

American Society of Refrigerating Engineers. Annual meeting at the Hotel New Yorker, New York City, Dec. 3-6. Secretary, David L. Fiske, 37 West 39th St., New York City.

Midwest Power Engineering Conference and Exposition. Fifth meeting in Chicago, Ill., Feb. 10-13, 1931. Secretary, George E. Pfisterer, 308 West Washington St., Chicago, Ill.

National Power Show. Grand Central Palace, New York City, Dec. 1-6. Manager, Charles F. Roth, Grand Central Palace, New York City.

Francis MacLehose, Power Superintendent, Dies

FRANCIS MACLEHOSE, superintendent of Waterside Stations 1 and 2 of the New York Edison Company, died Nov. 17 at his home in New York City after a long illness. He was born in East Orange, N. J., on Sept. 15, 1885, and was graduated as a mechanical engineer from Stevens Institute of Technology in 1905, immediately entering the employ of the New York Edison Company in its substations department.

Mr. MacLehose was transferred in 1908 to the generating department and sent to the Waterside stations. He was made assistant superintendent in 1915 and superintendent in 1926.

He was secretary of the Stevens Institute Alumni Association, a member of the American Society of Mechanical Engineers, the National Electric Light Association and the American Institute of Electrical Engineers.

DR. RICHARD G. G. MOLDENKE, one of the leading metallurgical experts of the United States, died Nov. 17 in the Muhlenberg Hospital, Plainfield, N. J., following a major operation. He was 66 and lived in Watchung, N. J. Born in Watertown, Wis., Dr. Moldenke graduated from Columbia University School of Mines in 1884 and received his doctor's degree in 1887. For a time he was interested in the development of electric power plants, but finally engaged in metallurgical work.

Personals

CHARLES E. BONINE, member of the firm of Bonine & Costa, consulting engineers of Philadelphia, Pa., has recently accepted the directorship of engineering for the Benjamin Franklin Memorial and Franklin Institute Museum. Mr. Bonine will retain his interest and active association with Bonine & Costa.

A. J. FOLEY recently resigned from the engineering department of Sargent & Lundy, Inc., of Chicago, Ill., to accept a position as manager of the Chicago sales office of the Neilan Company, Ltd., of Los Angeles, Calif.

JAMES W. OWENS, director of engineering for the Welding Engineering and Research Corporation of New York City, has been awarded the Samuel Wylie Miller Medal by the American Welding Society for his work in connection with the application of welding to marine construction.

T. CHALKLEY HATTON, consulting engineer of Milwaukee, Wis., was recently elected president of the Engineers' Society of Milwaukee for the year 1930-31. Other officers elected for that period are: vice-president, MAX ROTTER, consulting mechanical engineer of Milwaukee and vice-president in charge of engineering for the Busch-Sulzer Bros. Diesel Engine Company of St. Louis, Mo.; secretary, HUGO WILLIAM ROHDE; treasurer, WALTER R. MUELLER.

W. V. A. KEMP, former director of research of the National Research Council's Committee on Heat Transmission and more recently research secretary of the National Electric Light Association, has resigned in order to travel abroad. Mr. Kemp will study certain engineering developments in other countries and will return to the United States in about a year, at which time he will become actively engaged in further engineering work.

R. W. E. MOORE, engineering manager of association activities of the Westinghouse Electric & Manufacturing Company, was presented recently with the James H. McGraw Award, Manufacturer's Medal and Purse for 1930.

C. W. LEIHY, who has been associated with the General Electric Company for the past four years, the latter half of that period in sales engineering work in the company's Seattle office, has joined the staff of *Electrical West.*

VICTOR C. HOMERBERG, associate professor of physical metallurgy at the Massachusetts Institute of Technology, was recently appointed technical director of the Nitralloy Corporation of New York City. Dr. Homerberg is the author of a number of treatises on metallurgy and acts as a consultant for several manufacturing concerns.

Business Notes

READING IRON COMPANY, Philadelphia, Pa., announces that at a special meeting of the board of directors on Nov. 18 Presly N. Guthrie, Jr., was elected president of the company. Mr. Guthrie has been serving as vice-president in charge of sales for the past year. He succeeds Leon E. Thomas, who resigned on July 31. Since that time A. J. Maloney, chairman of the board, has performed the executive duties of the president, which will now be turned over to Mr. Guthrie.

LINK-BELT COMPANY, Philadelphia, Pa., announces the appointment of Frank W. Lovett as engineer in charge of sewage disposal equipment in the Western territory. Mr. Lovett is located at the company plant office, 300 West Pershing Road, Chicago, Ill., and his services are available to municipal and industrial sewage disposal plant engineers and managers.

SQUARE D COMPANY, Detroit, Mich., announces the appointment of C. L. Hull as sales manager of its Detroit division. Mr. Hull was formerly assistant sales manager under A. A. Schueler, who has been appointed sales manager of the Diamond Electrical Manufacturing Company, Ltd., of Los Angeles, San Francisco, Calif., and Houston, Texas, which is affiliated with the Square D Company. T. B. Martin is retained as sales manager of the industrial controller division of the company with offices and factory in Milwaukee, Wis.

BAILEY METER COMPANY, Cleveland, Ohio, announces that the rapid growth of its business in the Pacific Northwest has necessitated the opening of an office in that section. This office has been located at 406 East 80th St., Seattle, Wash., and is under the management of L. E. Evans. The company also announces that C. E. Albert has been appointed manager of the Kansas City office, located at 1010 Coca Cola Building. Mr. Albert was previously connected with the Houston, Texas, office.

STERLING ENGINE COMPANY, Hyde Park, Mass., announces the opening of a New York office at 900 Chrysler Building, New York City. William E. John is manager of the new office.

GODDARD-JACKSON SALES COMPANY, is a newly organized concern in Los Angeles, Calif., with headquarters at 1331 Santa Fe Avenue. It is selling and distributing in the West the products of the Detroit Oak Belting Company, Pacific Goodrich Company, Mikro Pulverizing Company, United States Electrical Manufacturing Company, Lansing Company, National Broach & Machine Company, Power Plant Equipment Company and Clipper Belt Lacer Company. Arthur C. Goddard and Gordon G. Jackson are the owners of the business.

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How's Business?

THE VISIBILITY is very low and does not increase as week by week we come nearer the veil that seems to shut off a clear view of 1931 prospects in business, commodity or security markets. A haze of uncertainty hangs over the efforts being made to stabilize commodity prices and to secure effective international financial cooperation toward restoring confidence in long-term investment. Steady vision is disturbed by the continued decline in indicators of business activity as we drift through the fag end of a poor year. Our index dropped off further, from 79.3 per cent to 78.2 per cent of normal, though the declining tendency is not as uniform as it has been in recent weeks. Beyond the turn of the year all that can be seen with reasonable certainty is improvement in steel under increased railroad and automotive demand, and in automobile production as deferred buying power comes into the market with the new year sales appeal:—*The Business Week,* Nov. 26.

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Trade Catalogs

POWER PLANT EQUIPMENT—An interesting and attractive bulletin has been issued by the Henry Vogt Machine Company, Louisville, Ky., to commemorate the anniversary of its fiftieth year in business. The bulletin relates the history of the company and illustrates its products — ice-making and refrigerating machinery, water-tube and horizontal - return - tubular boilers, oil-refinery equipment, drop-forged steel valves and fittings, and heat exchangers.

REFRACTORIES — McLeod & Henry Company, 31 Monroe St., Troy, N. Y., has just published a series of illustrated leaflets describing the application of "Carbex" bricks and blocks to high-temperature furnace linings. The company has also published a similar leaflet on "Steel Mixture" fire brick and cement for standard furnace linings and a handy information and data blank booklet for the convenience of engineers interested in receiving further information on boiler settings.

CONTROL DEVICES—Neilan Company, Ltd., 641-651 Santa Fe Ave., Los Angeles, Calif., is distributing a new and comprehensive instruction book, describing in detail how to hook up and adjust all Neilan control devices.

CONVEYORS — Bulletin 77 illustrating and describing briefly various types of material - handling equipment manufactured by the Robins Conveying Belt Company, 15 Park Row, New York.

FEED WATER TREATMENT—Cochrane Corporation, 17th St. and Allegheny Ave., Philadelphia, Pa., has just issued reprints of a paper entitled, "Hot Lime Soda Phosphate Treatment of Feed Water for High-Pressure Boilers," by C. E. Joos.

METAL CLEANING—A new 76-page illustrated booklet entitled, "The Cleaning of Metal," has just been issued by the Magnus Chemical Company of Garwood, N. J. It describes the processes, methods and materials used in cleaning metals.

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Fuel Prices

FUEL OIL

New York—Nov. 20, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4.5c. per gal.; f.o.b. Bayway, 36@40 deg., furnace, tank-car lots, 6c. per gal.

St. Louis—Nov. 12, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.345 per bbl., or 42 gal.; 26@28 deg., $1.47 per bbl.; 28@30 deg., $1.595 per bbl.; 30@32 deg., $1.695 per bbl.; 32@36 deg., gas oil, 4.026c. per gal.; 38@40 deg., distillate, 4.651c.@4.776c. per gal.

Pittsburgh—Nov. 12, f.o.b. local refinery, 34@36 deg., fuel oil, 3.62c.@3.87½c. per gal.; 36@40 deg., 3.62½c.@3.75c.

Philadelphia—Nov. 12, 13@19 deg., $1.05@$1.10 per bbl. or 42 gal.; 18 deg. plus, $1.475@$1.525 per bbl.; 23@27 deg., $2.00@$2.05 per bbl.

Cincinnati — Nov. 18, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5.25c. per gal.; 26@30 deg., 5.5c. per gal.; 30@32 deg., 5.75c. per gal.

Chicago—Nov. 15, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 70c. per bbl.; 26@30 deg., 80c.@90c. per bbl.; 30@32 deg., $1.00@$1.05 per bbl.

Boston—Nov. 17, tank-car lots, f.o.b. 12@14 deg., Baumé, 2.9c. per gal.; 28@32 deg., 4.85c. per gal.

Dallas—Nov. 15, f.o.b. local refinery 26@30 deg., $1.10 per bbl. or 42 gallons.

COAL

Bituminous (Net Tons)	At Mine, for Shipment to	Price per Ton
Pool 9, super low-vol..	New York...	$1.90 @$2.25
Pool 10, hr.gr. low-vol.	New York...	1.75 @ 1.85
Pool 11, low-vol.....	New York...	1.60 @ 1.75
Smokeless, mine-run..	Chicago.....	1.85 @ 2.25
Smokeless, slack.....	Chicago.....	.90 @ 1.25
Harlan, Ky., slack....	Chicago.....	.60 @ .85
Franklin, Ill., mine-run	Chicago.....	2.15
Franklin, Ill., screen...	Chicago.....	1.25 @ 1.60
Ind. 5th Vein, m.-r....	Chicago.....	1.30 @ 1.60
Standard Ill., mine-run	St. Louis.....	1.50
W. Ky., mine-run	Louisville....	1.00 @ 1.35
W. Ky., slack.....	Louisville....	.25 @ .50
Pittsburgh, mine-run.	Pittsburgh....	1.35 @ 1.45
Smokeless, mine-run..	Cincinnati...	1.75 @ 2.25
Smokeless, slack.....	Cincinnati...	.75 @ 1.35
Kanawha, mine-run..	Cincinnati...	1.10 @ 1.35
Kanawha, nut-slack.	Cincinnati...	.25 @ .75

Anthracite (Gross Tons)	At Mine, for Shipment to	Price per Ton
Buckwheat.....	New York...	$3.50
Barley.....	New York...	1.50

New Plant Construction

COMPILED BY THE MCGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., Agnew—Agnew State Hospital, awarded contract for a group of hospital buildings including ward, kitchen and steam heating plant, etc. to J. F. Shepherd, First National Bank Bldg., Stockton. Estimated total cost $257,470.

Conn., New London—Treasury Dept., Washington, D. C., will receive bids until Dec. 5 for the construction of a group of buildings including engineers buildings, steam laboratory, 53 x 85 ft. boiler house, etc. at Coast Guard Academy here. J. A. Wetmore, Acting Supervising Architect.

Conn., Wallingford—Connecticut Light & Power Co., Borough Electric Works, is having plans prepared for the construction of a substation and high tension transmission line from South Manchester. Estimated cost $85,000. Private plans.

D. C., Washington—Bureau of Yards & Docks, Navy Dept., will receive bids until Dec. 3 for the construction of a boiler plant.

Ill., Chicago—E. H. Siebel, 214 West Ohio St., is having sketches made for the construction of a 17 story stores and office building at Michigan Ave. and Ontario St. Estimated cost $3,000,000. Granger & Bollenbacher, 333 North Michigan Ave., are architects.

Ind., Indianapolis—Bd. Public Safety, will receive bids until Nov. 25 for repairing and reconstructing refrigeration plant at Indianapolis City Market.

La., Baton Rouge—State, H. P. Long, Governor, will receive bids until Dec. 10 for the construction of a 33 story capitol building including vacuum heating and ventilation systems, boilers, elevators, etc. Estimated cost $5,000,000. Weiss, Dreyfous & Seiferth, are architects.

La., Clinton—Mayor and Bd. of Alderman, will soon award contract for waterworks improvements including well, pump house, pumps, tank on tower, etc. Estimated cost $27,000. F. P. Joseph, Glenmore, is engineer.

La., New Orleans — Sewerage and Water Board, G. G. Earl, Gen. Supt., will receive bids until Dec. 30, for Cont. 118-D extension to drainage pumping station No. 7.

Md., Baltimore—T. Mullan, 3945 Greenmount Ave., had plans prepared for the construction of a 10 story apartment building including steam heating system, elevators, etc. at 39th St. and Canterbury Rd. Estimated cost $1,000,000. L. T. Rouleau, 2021 Massachusetts Ave., Washington, D. C., is architect.

Mass., Springfield—Springfield Hospital, 759 Chestnut St., awarded contract for the construction of a 7 story addition to hospital and service building including steam heating and ventilation systems, etc. at North Chestnut and Springfield Sts. to F. T. Ley & Co., Inc., 1215 Main St. Estimated cost $1,000,000.

Mo., Powersite—Empire District Electric Co., 414 Joplin St., Joplin, subsidiary of City Service Co., 60 Wall St., New York, N. Y., plans to expend $1,750,000 on improvements including two transmission lines and installation of new equipment at hydro-electric plant here to increase the capacity to 27,000 hp. Five new vertical type generators for 60 cycle current will replace the old horizontal water turbine of 25 cycle type; new step-down transformer station with automatic tap changers will also be included.

Neb., Hawthorne—Bureau of Yards & Docks, Navy Dept., Washington, D. C., is receiving bids for a group of buildings including boiler plant, etc. at Naval Ammunition Depot here. A. L. Parsons, is chief engineer.

Nev., Las Vegas—Dept. of Interior, Bureau of Reclamation, Washington, D. C., specifications for Hoover dam (Boulder dam) project including dam, diversion tunnels, cofferdam, spillway, outlet works and power plant, in the upper Black Canyon on the Colorado River about 30 miles southeast of Las Vegas on the Arizona-Nevada state line will be ready about Dec. 1 and call for bids issued at that time. Estimated cost approximately $108,800,000.

N. J., Browns Mills—F. Grad, 1023 Broad St., Newark, Archt., will receive bids about Dec. 15 for the construction of a sanitorium, including steam heating, ventilation and refrigeration systems, boilers, pumps, elevators, etc., here, for Deborah Jewish Relief Society, M. M. Unger, Chn., 763 Broad St., Newark. Estimated cost $600,000.

N. J., Newark—Prudential Life Insurance Co., Prudential Bldg., awarded contract for six 5 and 6 story apartment buildings at Frelinghuysen Ave. to Robert A. House, Jr., 763 Broad St. Estimated cost $1,000,000.

N. J., Paterson—Goodman & Shulman, 20 Smith St., Archts., will receive bids about Jan. 15 for the construction of a 10 story medical tower office building, including steam heating and ventilation systems, boilers, elevators, etc., at Broadway and Auburn St. for Medical Tower Building Corp., c/o architects. Estimated cost $600,000.

N. J., Skillman — Dept. of Institutions & Agencies, Trenton, will receive bids until Dec. 1 for electrical work for power house at State Epileptic Village here. Estimated cost $20,000.

N. Y., Brooklyn—Dept. of Water, Gas & Electricity, Municipal Bldg., New York, plans the construction of a 2 story water pumping station at Neptune Ave. and Bay View St. here. Estimated cost $150,000. D. M. Metcalfe, Huntington, L. I., is engineer.

N. Y., Middletown—Dept. of Mental Hygiene, State Office Bldg., Albany, will receive bids until Dec. 17, for refrigeration work for additions and alterations to Ashley Hall, Middletown State Homeopathic Hospital, here.

N. Y., New York—Mitchel Place Realty Co., c/o Bien & Prince, 415 Lexington Ave., Archts., awarded contract for the construction of a 17 story apartment building at Beekman and Mitchell Places, to Lane Ogle Inc., Pier 3, North River. Estimated cost $1,000,000.

N. Y., Poughkeepsie — Dept. of Mental Hygiene, State Office Building, Albany, will receive bids until Dec. 10 for the construction of a boiler house at Hudson River State Hospital here.

N. Y., Suffolk County — Dept. of Mental Hygiene, State Office Building, Albany, will receive bids until Dec. 17, for refrigeration work, heating work, etc. at Pilgrim State Hospital, Pine Air Station, here.

Pa., Tarentum—Boro of Tarentum, awarded contract for the construction of an electric light and water plant to Pitt Construction Co., Starr Bldg., Pittsburgh. Estimated total cost $150,000.

Tex., San Antonio—Society of Mary, c/o J. Waldron, 112 Pine St., will soon receive bids for foundations for academy including steam heating, ventilation and refrigeration systems, boilers, elevators, etc., on North St. Marys St. Estimated cost $600,000. H. Dresioerner, 3826 Arsenal St., St. Louis, Mo., is architect. Lilly & Drought, Smith-Young Tower, San Antonio, are engineers.

Va., Hampton Roads — Bureau of Yards & Docks, Navy Dept., Washington, D. C., will receive bids until Dec. 3 for addition to pump house, etc., here.

Va., Richmond—Lee Smith and Van Dervoort, 6th and Franklin Sts., Archts., preparing plans for an eleven story medical science building, including steam heating and refrigeration systems, etc., Franklin St. between Adams and Jefferson Sts. Estimated cost $575,000. Owner's name withheld. New York Contractors are reported to be interested in project.

Wash., Seattle—Insurance Building Corp., W. E. Johnson, Pres., plans the construction of a 13 story addition to office building at Second Ave. and Madison St. Estimated cost $1,000,000. Albertson, Wilson & Richardson, Henry Bldg., are architects.

Wash., Seattle—Treasury Dept., Washington, D. C., will receive bids about Jan. 1 for the construction of a building at First and Marion Sts., here. Estimated cost $2,225,000. C. E. Swift, Federal Constructing Engr.

Wash., Spokane—Spokane & Eastern Trust Co., J. L. Campbell, Secy., affiliated with Northwest Ban-corporation, 6th St. and Marquette Ave., Minneapolis, Minn., will receive bids until Dec. 5 for an 8 story bank and office building, including steam heating systems, etc., at Howard and Riverside Sts., here. Estimated cost $500,000. A. Moorman & Co., 813 First National Soo Line Bldg., Minneapolis, are architects.

Wash., Tacoma—City awarded contract for a regulating board and instruments for combustion control on two Sterling boilers in connection with steam generating plant on tideflats to Bailey Meter Co., 1038 Ivanhoe Rd., Cleveland, O., $27,734.

Ont., Thorold—Town, awarded contract for a 90,000 g.p.h. centrifugal pump to Turbine Equipment Co., 73 King St. W., Toronto.

Ont., Westboro—Nepean Township, will soon receive bids for the construction of pumping stations in connection with sewage treatment work.

Ont., Toronto—R. J. Sapera, 197 Spadina Ave., plans the construction of a 15 story loft building, including steam heating system, electric elevators, etc. Estimated cost $350,000. Kaplan & Sprachman, 305 Dundas St. W., are architects.

Equipment Wanted

Generator Sets—St. Louis, Mo.—U. S. Engineer, 428 Custom House, will receive bids until Dec. 10 for 1,000 kw. turbo- generator set, 100 kw. turbo-generator set and 1,000 hp. motor for Dredge Fort Chartress.

Motors, Etc.—Milwaukee, Wis.—Sewage Commission, will receive gids about Dec. 13 for motors and speed reducers for proposed conveying system of sludge in dryer house of sewage disposal plant $50,000.

Pumping Units—Wetumka, Okla.—City will receive bids until Dec. 1 for two motor driven pumping units for proposed waterworks improvements. Estimated cost $65,000.

Pumps, Etc.—Colchester, Ill.—City plans to purchase two centrifugal pumps, etc. for proposed waterworks system. Estimated cost $70,000.

Pumps and Generators—Lorain, O.—Bd. of Control, will soon receive bids for purchase and installation of four 24 m.g.p.d. electrical water pumps and two 420 Diesel generators to supply power to new pumps. Estimated cost $97,500.

Industrial Projects

Md., Baltimore—L. E. Mitchell, Inc., 915 East Monument St., (heating contractors) will build a 2 story, 54 x 140 ft. plant including machine shop at Cecil Ave. and 25th St.

Md., Baltimore — Pennsylvania R.R., Broad St. Station, Philadelphia, Pa., plans the construction of a produce terminal including refrigeration system, etc. at old Mount Vernon shops, North and Mount Royal Aves., here. Estimated cost to exceed $600,000. T. J. Skillman, Philadelphia, is chief engineer. Maturity after Jan. 1.

Mass., Watertown—New England Telephone & Telegraph Co., 245 State St., Boston, is receiving bids for the construction of factory here. Estimated cost to exceed $40,000. Monks & Johnson, 99 Chauncey St., Boston, are architects. Western Electric Co., 379 Summer St., Boston, is lessee.

Mass., Worcester — Northeastern Storage & Distribution Corp., 93 Grafton St., is having plans prepared for the construction of a warehouse and freight terminal at Grafton St. and Keefe Pl. Estimated cost $1,000,000. J. Rice, and F. B. Hoffman, 147 East 51st St., New York, are architects.

N. J., Newark—Marshall N. Shoemaker, 10 Bleeker St., Archt., will receive bids about Dec. 15 for the construction of a 2 story addition to factory at 361-65 6th Ave. for Weldron Roberts Rubber Co., 18 Oliver St. Estimated cost $40,000.

N. J., Trenton—Trenton Potteries Co., North Clinton Ave. and Ott St., will soon award contract for the construction of a 1 story pottery plant. Estimated cost $40,000. Lockwood, Greene Engrs Inc., 100 East 42nd St., New York, N. Y., are architects and engineers.

O., Cleveland—Bryant Heater & Mfg. Co., J. E. Kinner, Pres., 7225 St. Clair Ave., plans addition to factory. Estimated cost $200,000. Fox, Duthie & Foose, 1936 Union Trust Bldg., are architects.

O., Cleveland — Karl Kreinberg and W. A. Krasny, 3310 West 65th St., awarded contract for a 1 story, 40 x 150 ft. cooler building to Tepper & Limovitz, 3468 East 123rd St. Estimated cost $50,000.

O., Columbiana — U. S. Standard Mfg. Co., awarded contract for a 1 story, 60 x 105 ft. factory at Railroad and Spruce Sts. to R. W. Heck, East Palestine. Estimated cost $33,000.

Pa., Ambridge — National Electric Products Corp., 233 Broadway, New York, N. Y., plans expansion in line of manufacturing of additional products made of copper. Estimated cost to exceed $40,000. Maturity indefinite.

Ont., Gravenhurst — Rainbow Boat Works Ltd., awarded contract for a 1 story, 70 x 250 ft. factory to J. R. Carson, Orillia. Estimated cost $100,000 Complete equipment will be required.

Ont., Hamilton—Manufacturers Natural Gas Co. Ltd., is having plans prepared for the construction of a compressor plant, purification plant and gas mains at Burlington, Sherman and Barton Sts. Estimated cost $1,000,000.

Ont., Hamilton—Steel Co. of Canada, H. H. Champ, Gen. Mgr., plans additions to plant and installation of equipment. Estimated cost $1,500,000.